# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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**MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.**

## *THE RUMFORD FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES.*[1]

BENJAMIN THOMPSON, COUNT RUMFORD, was born at Woburn, Mass., March 26, 1753, and died at Auteuil, France, August 21, 1814. During his boyhood he showed an intense interest in scientific matters and attended scientific lectures at Harvard College. Afterwards he studied medicine, though he never practised, and taught school at Concord, N. H. He was suspected of being unfriendly to the cause of liberty in the war of the Revolution, and on the evacuation of Boston by the British —in March, 1776—he went to England.

Here he prosecuted various scientific researches, and was elected a fellow of the Royal Society in 1779. He subsequently entered the employ of Prince Maximilian of Bavaria, to whom he was of great service, reorganizing the army, instituting important social reforms, and at the same time prosecuting valuable scientific researches. Of these the most noteworthy was his well-known investigation into the cause of the heat produced by friction, by which he conclusively disproved the hypothesis of the fluid nature of heat, and laid an important stone in the foundation of the doctrine of the conservation of energy. He was created a count by Prince Maximilian, and chose the title Count Rumford, after the New Hampshire town from which the family of his wife had come.

In 1799 he returned to England, and soon after projected the Royal Institution of Great Britain. He went to France in

[1] Published by the Academy.

1864, subsequently married the widow of Lavoisier, and died in 1814. By a bequest in his will he founded the Rumford Professorship of the Application of Science to the Useful Arts in Harvard University.

The Rumford Fund had its origin in the gift by Count Rumford to the American Academy of Arts and Sciences of the sum of $5,000; which was simultaneous with the gift of a like sum, £1,000, to the Royal Society of Great Britain. The purpose of the fund was the same in each case, the award of a suitable premium for discoveries or improvements in heat and light.

The intention of the donor was announced to the academy in the following letter:

LONDON, July 12, 1796.

*To the Hon. John Adams, President of the American Academy of Arts and Sciences:*

SIR,—Desirous of contributing efficaciously to the advancement of a branch of science which has long employed my attention, and which appears to me to be of the highest importance to mankind, and wishing at the same time to leave a lasting testimony of my respect for the American Academy of Arts and Sciences, I take the liberty to request that the academy would do me the honor to accept of five thousand dollars, three per cent. stock in the funds of the United States of North America, which stock I have actually purchased, and which I beg leave to transfer to the fellows of the academy, to the end that the interest of the same may be by them, and by their successors, received from time to time, forever, and the amount of the same applied and given once every second year, as a premium, to the author of the most important discovery or useful improvement, which shall be made and published by printing, or in any way made known to the public, in any part of the continent of America, or in any of the American islands during the preceding two years, on heat, or on light; the preference always being given to such discoveries as shall, in the opinion of the academy, tend most to promote the good of mankind.

With regard to the formalities to be observed by the academy in their decisions upon the comparative merits of those discoveries which in the opinion of the academy may entitle their authors to be considered as competitors for this biennial premium, the academy will be pleased to adopt such regulations as they in their wisdom may judge to be proper and necessary.

But in regard to the form in which this premium is conferred, I take the liberty to request that it may always be given in two medals, struck in the same die, the one of gold and the other of silver, and of such dimensions that both of them together may be just equal in intrinsic value to the amount of interest of the aforesaid five thousand dollars stock during two years: that is to say, that they may together be of the value of three hundred dollars.

The academy will be pleased to order such device or inscription to be engraved on the die they shall cause to be prepared for striking these medals, as they may judge proper.

If during any term of two years, reckoning from the last adjudication, or from the period for the adjudication of this premium by the academy, no new discovery or improvement should be made in any part of America, relative to either of the subjects in question (heat or light), which, in the opinion of the academy shall be of sufficient importance to deserve this premium, in that case, it is my desire that the premium may not be given, but that the value of it may be reserved, and by laying out in the purchase of additional stock in the American funds may be applied to augment the capital of this premium; and that the interest of the sums by which the capital may, from time to time, be so augmented, may regularly be given in money with the two medals, and as an addition to the original premium at each succeeding adjudication of it. And it is further my particular request that those additions to the value of the premium arising from its occasional non-adjudication may be suffered to increase without limitation.

With the highest respect for the American Academy of Arts and Sciences, and the most earnest wishes for their success in their labors for the good of mankind,

I have the honor to be, with much esteem and regard, sir,

Your most obedient, humble servant,

RUMFORD.

The gift was accepted by the academy, but for many years no award of the premium was made as no claimant appeared whose merit was such in its opinion as to justify this. Meanwhile the fund had accumulated to the amount of $20,000, and

in view of the fact that there was no possibility of expending the income in the precise manner contemplated by Count Rumford, application was made in 1831 to the Supreme Court of the Commonwealth of Massachusetts for relief, if such should be possible.

The court issued a decree which modified the possible disposition of the income of the fund in such a manner as to increase its usefulness while keeping entirely within the spirit of the original gift, saying in part as follows:

It further appears that the said donation was made to the American Academy for a general purpose of charity, that, namely, of promoting a useful branch of science for the benefit of mankind; that the academy accepted the same, upon the terms stated, and for the purposes contemplated by said donation, and are now under obligation to carry the general intent of the donor into effect, as far as it is practicable to do so. It further appears, that, in consequence of the impediments set forth in the bill, it is impracticable for the academy to carry the general charitable intent of the donor into effect in the exact and precise mode specified by him; but, considering the general and primary intent of Count Rumford to have been to awaken and stimulate the ingenuity, and encourage the researches and experiments of individuals on the continent or the islands of America to make important discoveries or useful improvements upon the subjects of light and heat, and to cause them speedily to be published for the good of mankind, it does appear to the court that it is quite practicable for the academy to accomplish and carry into effect the general charitable intent and purpose of Count Rumford by some slight alterations in the mode particularly prescribed by him for carrying the same into effect.

It is therefore by the court ordered, adjudged and decreed, for the reasons set forth in the bill, that the plaintiffs be, and they are by the authority of this court, empowered to make from the income of said fund, as it now exists, at any annual meeting of the academy, instead of biennially, as directed by the said Benjamin Count Rumford, award of a gold and silver medal, being together of the intrinsic value of three hundred dollars, as a premium to the author of any important discovery or useful improvement on heat or on light which shall have been made and published by printing or in any way made known to the public, in any part of the continent of America, or any of the American islands, preference being always given to such discoveries as shall, in the opinion of the academy, tend most to promote the good of mankind; and to add to such medals as a further reward and premium of such discovery or improvement, if the plaintiffs see fit so to do, a sum of money not exceeding three hundred dollars.

And it is further ordered, adjudged and decreed, that the plaintiffs may appropriate from time to time, as the same can advantageously be done, the residue of the income of said fund hereafter to be received, and not so as aforesaid awarded in premiums, to the purchase of such books and papers and philosophical apparatus (to be the property of said academy) and in making such publications or procuring such lectures, experiments, or investigations, as shall in their opinion best facilitate and encourage the making of discoveries and improvements which may merit the premium so as aforesaid to be by them awarded. And that the books, papers and apparatus so purchased shall be used, and such lectures, experiments and investigations be delivered and made, either in the said academy or elsewhere, as the plaintiffs shall think best adapted to promote such discoveries and improvements as aforesaid, and either by the Rumford Professor of Harvard University or by any other person or persons, as to the plaintiffs shall from time to time seem best.

In considering this action of the court, Dr. George E. Ellis, the biographer of Count Rumford, makes the following comment:

It is easy to express the obvious suggestion, that the enlargement and direction thus allowed by judicial decision to the use of the trust fund committed by Count Rumford to the academy, for one specified and well-defined object, exceed any possible construction that can be put upon the liberal terms of his deed of gift. But it is just as easy to meet the suggestion by affirming that the judicial decree has in view, and aims, it may even be said, most conscientiously to fulfil the intent of the donor. Under its decision the academy may make the munificence of Count Rumford most serviceable at the fountain-head and sources of that scientific development which alone can secure biennially, or at longer or shorter in-

tervals, a signal result marking a point in the flow of the stream. Books and lectures presenting the last discoveries, or methods for discovery, in the count's favorite subjects of experiment, may be regarded as even something better than an alternative in the improvement of his fund, to the use of it for a medal or premium under the pressure of a supposed obligation to bestow it with chief reference to the lapse of two years.

In view of all the circumstances and of the difficulties which the case presented, one may reasonably affirm that when the honored and venerated chief-justice gave validity to the decree of the court, he might have felt the full assurance that Count Rumford himself would have dictated its terms.

At the close of the last fiscal year of the academy (1904–05) the Rumford Fund amounted to $58,722.16, the income for that year having been $2,550.73.

A standing committee of the academy known as the Rumford Committee, consisting of seven fellows, is charged with the supervision of the trust created by Count Rumford, and considers all applications and claims for the Rumford premium, and all applications made for grants from the income of the fund in aid of research or for other purposes.

The Rumford Committee was first constituted a standing committee in 1833. Its members were nominated annually by the president of the academy until 1863, since which time they have been chosen in the same manner as the other officers.

The following is a list of those who have been members of the committee:

MEMBERS OF THE RUMFORD COMMITTEE, 1833-1905.

1833–1838, Nathaniel Bowditch.
1833–1837, Francis C. Gray.
1833–1848, Daniel Treadwell.
1833–1846, Jacob Bigelow.
1833–1849, John Ware.
1837–1846, John Pickering.
1838–1839, James Jackson.
1839–1840, Benjamin Peirce.
1840–1843, George B. Emerson.
1843–1849, Benjamin Peirce.
1846–1850, Francis C. Lowell.
1846–1847, James Hayward.
1847–1868, Joseph Lovering.
1848–1863, Eben N. Horsford.
1849–1863, Daniel Treadwell.
1849–1878, Morrill Wyman.
1850–1862, Henry L. Eustis.
1862–1871, Joseph Winlock.
1863–1869, William B. Rogers.
1863–1864, Charles W. Eliot.
1863–1864, Theophilus Parsons.
1863–1866, Cyrus M. Warren.
1864–1894, Wolcott Gibbs.
1864–1871, Francis H. Storer.
1866–1877, Josiah P. Cooke.
1868–1878, James B. Francis.
1869–1890, Edward C. Pickering.
1871–1885, John M. Ordway.
1871–1880, Stephen P. Ruggles.
1877–1897, John Trowbridge.
1878–1892, Josiah P. Cooke.
1878–1892, Joseph Lovering.
1880–1891, George B. Clark.
1885– Erasmus D. Leavitt.
1890–1896, Benjamin O. Peirce.
1892– Edward C. Pickering.
1892– Amos E. Dolbear.
1892– Charles R. Cross.
1894–1896, Benjamin A. Gould.
1896– Arthur G. Webster.
1897–1902, Thomas C. Mendenhall.
1897– Theodore W. Richards.
1902– Elihu Thomson.

The successive chairmen of the Rumford Committee up to the present time have been the following: Messrs. Nathaniel Bowditch (1833–1838), James Jackson (1838–1839), John Pickering (1839–1846), Daniel Treadwell (1846–1848), Eben N. Horsford (1848–1863), Joseph Lovering (1863–1868), Joseph Winlock (1868–1871), Josiah P. Cooke (1871–1876), Morrill Wyman (1876–1878), Joseph Lovering (1878–1892), John Trowbridge (1892–1897), Charles R. Cross (1897–).

The Rumford premium is awarded by the academy upon the recommendation of the Rumford Committee. It has been given to the following persons and on the ground stated:

AWARDS OF THE RUMFORD PREMIUM OF THE AMERICAN ACADEMY.

1839. Robert Hare, of Philadelphia, for his invention of the compound or oxyhydrogen blowpipe.

1862. John Ericsson, of New York, for his improvements in the management of heat, particularly as shown in his caloric engine of 1855.

1865. Daniel Treadwell, of Cambridge, for improvements in the management of heat, embodied in his investigations and inventions relating to the construction of cannon of large calibre, and of great strength and endurance.

1866. Alvan Clark, of Cambridge, for his improvements in the manufacture of refracting telescopes, as exhibited in his method of local correction.

1869. George Henry Corliss, of Providence, for his improvement in the steam-engine.

1871. Joseph Harrison, Jr., of Philadelphia, for his mode of constructing steam-boilers, by which great safety has been secured.

1873. Lewis Morris Rutherfurd, of New York, for his improvements in the processes and methods of astronomical photography.

1875. John William Draper, of New York, for his researches on radiant energy.

1880. Josiah Willard Gibbs, of New Haven, for his researches in thermodynamics.

1883. Henry Augustus Rowland, of Baltimore, for his researches in light and heat.

1886. Samuel Pierpont Langley, of Allegheny, for his researches in radiant energy.

1888. Albert Abraham Michelson, of Cleveland, for his determination of the velocity of light, for his researches upon the motion of the luminiferous ether, and for his work on the absolute determination of the wave-lengths of light.

1891. Edward Charles Pickering, of Cambridge, for his work on the photometry of the stars and upon stellar spectra.

1895. Thomas Alva Edison, of Orange, N. J., for his investigations in electric lighting.

1898. James Edward Keeler, of Allegheny, for his application of the spectroscope to astronomical problems, and especially for his investigations of the proper motions of the nebulæ, and the physical constitution of the rings of the planet Saturn, by the use of that instrument.

1899. Charles Francis Brush, of Cleveland, for the practical development of electric arc-lighting.

1900. Carl Barus, of Providence, for his various researches in heat.

1901. Elihu Thomson, of Lynn, for his inventions in electric welding and lighting.

1902. George Ellery Hale, of Chicago, for his investigations in solar and stellar physics and in particular for the invention and perfection of the spectro-heliograph.

1904. Ernest Fox Nichols, of New York, for his researches on radiation, particularly on the pressure due to radiation, the heat of the stars, and the infra-red spectrum.

The Rumford Fund of the Royal Society has been devoted solely to the award of the premium according to the original provisions of that trust. For purposes of comparison with the foregoing the following list of grantees of the Royal Society's Rumford Premium is given:

AWARDS OF THE RUMFORD PREMIUM OF THE ROYAL SOCIETY.

1802. Benjamin Count Rumford, for his various discoveries respecting light and heat.

1804. John Leslie, experiments on heat.

1806. William Murdock, publication on the employment of gas from coal for the purpose of illumination.

1810. Etienne Louis Malus, discovery of certain properties of reflected light.

1814. William Charles Wells, essay on dew.

1816. Humphry Davy, papers on combustion and flame.

1818. David Brewster, discoveries relating to the polarization of light.

1824. Augustin Jean Fresnel, development of the undulatory theory, as applied to the phenomena of polarized light: and various important discoveries in physical optics.

1832. John Frederic Daniell, experiments with a new register pyrometer for measuring the expansion of solids.

1834. Macedonio Melloni, discoveries relative to radiant heat.

1838. James David Forbes, experiments on the polarization of heat.

1840. Jean Baptiste Biot, researches in and connected with the circular polarization of light.

1842. Henry Fox Talbot, discoveries and improvements in photography.

1846. Michael Faraday, discovery of the optical phenomena developed by the action of magnets and electric currents in certain transparent media.

1848. Henri Victor Regnault, experiments on expansion and density of air, different gases and mercury.

1850. François Jean Dominique Arago, experimental investigation of polarized light.

1852. George Gabriel Stokes, on the change of refrangibility of light.

1854. Neil Arnott, a new smoke-consuming and fuel-saving fireplace.

1856. Louis Pasteur, discovery of the nature of racemic acid, and its relations to polarized light.

1858. Jules Célestin Jamin, various experimental researches on light.

1860. James Clerk Maxwell, researches on the composition of colors and other optical papers.

1862. Gustav Robert Kirchhoff, researches on the fixed lines of the solar spectrum and on the inversion of the bright lines in the spectra of artificial light.

1864. John Tyndall, researches on the absorption and radiation of heat by gases and vapors.

1866. Armand Hippolyte Louis Fizeau, optical researches and investigations into the effect of heat on the refractive power of transparent bodies.

1868. Balfour Stewart, researches on the qualitative as well as quantitative relations between the powers of emission and absorption of bodies for heat and light.

1870. Alfred Olivier Des Cloizeaux, researches in mineralogical optics.

1872. Anders Jonas Angström, researches on spectral analysis.

1874. Joseph Norman Lockyer, spectroscopic researches on the sun and on the chemical elements.

1876. Pierre Jules César Janssen, researches on the radiation and absorption of light, carried on chiefly by means of the spectroscope.

1878. Alfred Cornu, optical researches, and especially his recent redetermination of the velocity of propagation of light.

1880. William Huggins, astronomical researches.

1882. William de Wiveleslie Abney, contributions to the advancement of the theory and practise of photography.

1884. Tobias Robert Thalén, spectroscopic researches.

1886. Samuel Pierpont Langley, researches on the spectrum by means of the bolometer.

1888. Pietro Tacchini, important and long-continued investigations which have largely advanced our knowledge of the physics of the sun.

1890. Heinrich Hertz, work on electro-magnetic radiation.

1892. Nils Christofer Dunér, astronomical observations.

1894. James Dewar, researches at very high and very low temperatures, and on spectroscopic phenomena.

1896. Philipp Lenard and Wilhelm Konrad Röntgen, researches on phenomena which occur outside a highly exhausted tube through which an electrical discharge is passing.

1898. Oliver Joseph Lodge, researches on radiation and on the relations between matter and ether.

1900. Antoine Henri Becquerel, discoveries in radiation proceeding from uranium.

1902. Charles Algernon Parsons, application of the steam turbine to industrial purposes and its recent extension to navigation.

1904. Ernest Rutherford, researches on radioactivity, and particularly his discovery of the existence and properties of the gaseous emanations from radio-active bodies.

The following is a list of grants made from the income of the Rumford Fund of the American Academy in furtherance of research. In a few cases the appropriation has not been called for because the research in question has not proved feasible, because funds have been provided from elsewhere, or for other reasons. When this is believed to be the case it is so stated.

GRANTS FROM THE RUMFORD FUND.

1832–1862. Observatory at Cambridge, for telescope and other apparatus........ $3,776

Enoth Hale. For rain gauges and sundry expenses for experiments and investigations relating to the fall of rain 1,697

1862. Philander Shaw. Experiments relating to air engines................ 600

1863. Ogden N. Rood. Physical relations of iodized plate to light. (Appropriation subsequently transferred to another research, viz., photometry.).... 300

1864. Wolcott Gibbs. For purchase of a Meyerstein spectrometer and Regnault's apparatus for measuring vapor-tension ........................... 600

Josiah P. Cooke, Jr. For purchase of glass prisms to be used in an investigation of metallic spectra. (These prisms were purchased from the academy by Professor Cooke in 1871.).... 200

1866. Ogden N. Rood. Photometry. (Appropriation of 1863 for relations of

iodized plate to light, $300, transferred to this purpose.)

1867. Wolcott Gibbs. For repairing Meyerstein spectrometer belonging to the academy ........ 100

1869. Joseph Winlock. For purchase of spectroscopic instruments for observations of the solar eclipse of August, 1869 ........ 300

1870. Benjamin Apthorp Gould. For photometric and spectroscopic apparatus for the observatory at Cordova. (Apparatus subsequently purchased by the Argentine government.) ........ 500

1875. John Trowbridge. Improvement of magneto-electric machine and induction coil ........ 500

1876. Henry A. Rowland. New determination of mechanical equivalent of heat. 600

Samuel P. Langley. Researches on radiant energy ........ 600

1877. Benjamin O. Peirce, Jr. Investigation of the conduction of heat in the interior of bodies. ($60, only, called for.) ........ 200

Edward C. Pickering. Atmospheric refraction ........ 520

1878. Wolcott Gibbs, John Trowbridge, Edward C. Pickering. Experiments on photometry and polarimetry. (A small portion only of this appropriation was called for.) ........ 500

Charles A. Young. In aid of observations on solar eclipse of July 29, 1878. (Appropriation not called for.) ........ 300

Nathaniel S. Shaler. Investigation on loss of internal heat of earth in the neighborhood of Boston. (Appropriation not called for.) ........ 200

William W. Jacques. Experiments on the distribution of heat in the spectrum ........ 100

Wolcott Gibbs, Edward C. Pickering, John Trowbridge. Determination of indices of refraction. (A small portion only of this appropriation was called for.) ........ 500

1879. John Trowbridge. Heat developed by magnetization and demagnetization of magnetic metals ........ 200

William W. Jacques. Radiation at high temperatures ........ 200

William A. Rogers. To procure a metric standard of length ........ 350

1880. Silas W. Holman. Viscosity of gases 250

Wolcott Gibbs. Construction of dynamo-electric machine of a new plan ........ 150

Samuel P. Langley. Distribution of heat in diffraction spectrum ........ 300

1882. Edward C. Pickering. Stellar photography, with a view of obtaining a method of estimating the brightness of stars ........ 500

John Trowbridge. Thomson effect and allied subjects ........ 250

1883. John Trowbridge. Addition to last preceding appropriation ........ 100

Frank N. Cole. Experiments on Maxwell's theory of light ........ 50

1884. Rumford Committee. For purchase of Rowland grating ........ 40

William H. Pickering. Experiments in photography ........ 200

John Trowbridge, Edward C. Pickering, Charles R. Cross. Experiments on standard of light ........ 300

Edward C. Pickering. Photometry ..... 200

William A. Rogers. Production of constant temperatures ........ 100

John Trowbridge. Effect of changes of temperature on magnetism ........ 100

1885. William A. Rogers. For construction of constant temperature room. (Addition to former appropriation.) .. 82

Edward C. Pickering. Photometry ..... 300

William H. Pickering. Photography and new standard of light ........ 300

1886. William H. Pickering. Observations of solar corona, eclipse of August, 1886 500

Henry P. Bowditch. Calorimetric observations on the heat of the human body. ($100, only, called for.) ...... 500

John Trowbridge. Standard of light. (Appropriation subsequently transferred to another research, viz., radiant energy.) ........ 250

Charles R. Cross. Thermo-electric effect in Munich shunt method. (Appropriation not called for.) ........ 75

1887. John Trowbridge. Investigations on radiant energy. (Appropriation of 1886 for standard of light, $250, transferred to this purpose.)

Charles R. Cross and Silas W. Holman. Thermometry ........ 250

Erasmus D. Leavitt, Jr. Investigations upon a pyrometer. (Appropriation not called for.) ........ 250

John Trowbridge. Metallic spectra ..... 250

1888. John Trowbridge. Metallic spectra. (Addition to former appropriation.) . 500
William H. Pickering. For observations on solar eclipse of January, 1889..... 500
1889. Charles C. Hutchins. Investigation on lunar radiation.................. 250
Edwin H. Hall. Heat development in cylinder of steam-engine............. 100
Henry A. Rowland. Metallic spectra... 500
1890. Edwin H. Hall. Investigations on cylinder temperature ................ 100
Benjamin O. Peirce. Temperature changes in interior of solids. (Appropriation not called for.).......... 200
1892. Daniel W. Shea. Velocity of light in magnetic field.................... 250
Benjamin O. Peirce. Propagation of heat within certain solid bodies........... 200
Henry A. Rowland. Investigations on solar spectrum ..................... 250
1893. William A. Rogers. Investigation on the pulsation of thermometers..... 175
William H. Pickering. Observations in Arizona on transparency and steadiness of the air and on the changes in temperature on the planet Mars. (Appropriation not called for.).......... 500
1894. Frank A. Laws. Thermal conductivity of metals..................... 300
Edward L. Nichols. Radiation from carbon at different temperatures......... 250
1895. Edwin H. Hall. Thermal conductivity of metals.................... 250
Arthur G. Webster. Velocity of electric waves ............................ 250
Benjamin O. Peirce. Thermal conductivities of poor conductors........... 250
1896. Henry Crew. Electric, chemical and thermal effects of electric arc........ 400
Robert O. King. Thomson effect in metals ........................... 100
1897. Arthur G. Webster. Velocity of light. (Appropriation not called for.) 500
George E. Hale. Construction of spectroheliograph ......................... 400
Arthur G. Webster. Construction of revolving mirror ..................... 250
Arthur G. Webster and Robert R. Tatnall. The Zeeman effect.................. 100
1898. Wallace C. Sabine. Researches on ultra-violet radiation ............... 400
Albert A. Michelson. New form of diffraction grating. (Echelon spectroscope.) ........................... 500
Theodore W. Richards. For the construction of a microkinetoscope, to be applied to a study of the birth and growth of crystals.................. 200
1899. Wallace C. Sabine. Further researches on ultra-violet wave-length.. 200
Henry Crew. Spectrum of the electric arc .............................. 200
Arthur G. Webster. Distribution of energy in various spectra studied by means of the Michelson interferometer and the radiometer. (Appropriation not called for.)..................... 200
Edwin B. Frost. To aid in construction of a spectrograph especially designed for the measurement of stellar velocities in the line of sight............. 500
1900. Edward C. Pickering. For constructing a new type of photometer to be used in an investigation on the brightness of faint stars, to be carried out by cooperation with certain observatories possessing large telescopes... 500
Theodore W. Richards. Transition temperatures of crystallized salts........ 100
Arthur L. Clark. Molecular properties of vapors in the neighborhood of the critical point ....................... 250
Charles E. Mendenhall. Investigations on a hollow bolometer. ($100, only, called for.) ........................ 200
George E. Hale. Application of the radiometer to the study of the infrared spectrum of the chromosphere.... 500
Arthur A. Noyes. Effect of high temperatures on the electrical conductivity of salt solutions.................... 300
1901. Theodore W. Richards. Research on the expansion of gases.............. 500
Henry Crew. Order of appearance of the different lines of the spark spectrum.. 100
Robert W. Wood. Anomalous dispersion of sodium vapor .................. 350
Arthur G. Webster. For purchase of fluorite plates ...................... 65
1902. Ernest F. Nichols. For the purchase of a spectrometer, in furtherance of a research on resonance in connection with heat radiations................ 300
Theodore W. Richards. For the construction of a mercurial compression pump to be used in a research on the Joule-Thomson effect. (Appropriation subsequently transferred to another re-

search, viz., the experimental study of chemical thermodynamics.) .......... 750

Arthur A. Noyes. Effect of high temperatures on the electrical conductivity of aqueous solutions................ 300

Ralph S. Minor. Dispersion and absorption of substances for ultra-violet radiation .......................... 150

1903. Theodore W. Richards. The experimental study of chemical thermodynamics. (Appropriation of 1902 for compression pump, $750, transferred to this purpose.)

Sidney D. Townley. For the construction of a stellar photometer.......... 100

Edwin B. Frost. For the construction of a special lens for use in connection with the stellar spectrograph of the Yerkes Observatory for the study of radial velocities of faint stars....... 200

Ernest F. Nichols and Gordon F. Hull. In aid of the investigation of the relative motion of the earth and the ether by the method of 'Fizeau's polarization experiment.' (Appropriation transferred to another research, viz., effect of motion of earth on intensity of radiation.)...................... 250

George E. Hale. For the purchase of a Rowland concave diffraction grating to be used in the photographic study of the brighter stars.................. 300

Edward C. Pickering. For the construction of two stellar photometers to be placed at the disposal of the Rumford committee ......................... 150

Ernest F. Nichols and Gordon F. Hull. Effect of the motion of the earth on the intensity of radiation. (Appropriation for Fizeau's polarization experiment, $250, transferred to this purpose.)

Frederic L. Bishop. Thermal conductivity of lead...................... 75

Frederick A. Saunders. Characteristics of spectra produced under varying conditions ............................ 200

William J. Humphreys. Shift of spectrum lines due to pressure........... 300

Norton A. Kent. Circuit conditions influencing electric spark lines......... 250

Edward W. Morley. Nature and effects of ether drift ..................... 500

1904. John A. Dunne. Fluctuations in solar activity as evinced by changes in the difference between maximum and mimimum temperatures ............. 200

Carl Barus. Optical method of study of radioactively produced condensation nuclei. (Appropriation not yet called for.) ............................. 200

DeWitt B. Brace. Double refraction in gases in an electrical field........... 200

Robert W. Wood. Optical and other physical properties of sodium vapor.. 350

Norton A. Kent (addition to former appropriation). Circuit conditions influencing electric spark lines........ 100

Arthur L. Clark (addition to former appropriation). Molecular properties of vapors in the neighborhood of the critical point ......................... 150

1905. DeWitt B. Brace (addition to former appropriation). Double refraction in gases in an electrical field........... 200

Charles B. Thwing. Thermo-electric force of metals and alloys........... 150

Harry W. Morse. Fluorescence........ 500

John Trowbridge. Electric double refraction of light....................... 200

Edwin H. Hall. Thermal and thermoelectric properties of iron and other metals ........................... 200

The Rumford Committee will at any time receive applications for aid from the Rumford Fund in furtherance of researches in heat or light. Such applications may be sent to the chairman of the committee or to any of its members in care of the American Academy of Arts and Sciences, Boston, Mass. Full statements should be made as to the object of the investigation for which aid is asked. A report of work is expected yearly as to the progress of the research for which a grant has been made. All apparatus purchased from appropriations from the Rumford Fund is the property of the academy and is to be returned to it when the research in question is completed.

The rule as to publication of papers embodying the results of investigations furthered by grants from the fund is indicated in a vote of the Rumford Committee, passed June 8, 1898.

EXTRACT FROM THE RECORDS OF THE RUMFORD COMMITTEE.

It was voted that in the judgment of the committee, persons carrying on researches with the aid of the Rumford fund should submit to the academy an account of their researches not less complete than that published elsewhere. These researches may be published in any place or form, with the proviso that due recognition be made of the grant, and of the presentation of the paper to the academy.

## *SCIENTIFIC BOOKS.*

### THE INTERNATIONAL CODE OF ZOOLOGICAL NOMENCLATURE AS APPLIED TO MEDICINE.

As Bulletin No. 24 of the Hygienic Laboratory of the Public Health and Marine Service of the United States, Dr. Charles Wardell Stiles has reprinted the English text of the recently adopted 'International Code of Zoological Nomenclature, with remarks and a discussion of its application to animals concerned in medical pathology.

This code was drawn up after several preliminary meetings and discussions at the fifth International Zoological Congress at Berlin (1901) and was adopted in printed form at the sixth congress at Berne (1904).

It is based on a number of earlier codes, the 'Stricklandian Code' (1842–3), the 'Dall Code' (1877) and the 'Code of the American Ornithologists Union' (1885), being historically among the most important of these. The present code is the work of a commission composed of Raphael Blanchard, of Paris; J. V. Carus, of Leipzig; F. A. Jentink, of Leyden; P. L. Slater, of London, and C. W. Stiles, of Washington. The final editors were Blanchard, von Maerenthal and Stiles.

At Berne, a larger permanent commission was organized, so constituted that five members retire every three years, and the present membership is as follows: Retiring in 1907, R. Horst, of Leyden; J. A. Jentink, of Leyden; D. S. Jordan, of Stanford; F. E. Schulze, of Berlin, and L. Stejneger, of Washington. In 1910, R. Blanchard, of Paris; L. Joubin, of Paris; C. W. Stiles, of Washington; Th. Studer, of Berne, and R. R. Wright, of Toronto. In 1913, Ph. Dautzenberg, of Paris; W. E. Hoyle, of Manchester; L. von Graff, of Graz; F. C. von Maerenthal, of Berlin, and H. L. Osborn, of Columbia. This broad representation among men of various nations and specialties engaged in common problems should go far toward securing acceptance of the rules adapted—though the final test must be their actual fitness to the purpose for which they are adapted.

In 1886, Ludwig estimated the number of known species of animals at 312,015. Since that time, nearly half as many more have been added, and the actual number of species of insects alone, known and unknown, is estimated by Dr. L. O. Howard at nearly 4,000,000.

About 120,000 generic names have been applied to animals, and the number increases at the rate of about 1,150 per year. As much of the world is still virtually unexplored, Dr. Stiles concludes:

> The known genera and species of animals represent but a fraction (but ten to twenty per cent.) of the zoological names which will come into use during the next two or three centuries. It is clear that our nomenclatural tasks are easy, compared with the tremendous number of technical names the future generations will fall heir to. Under these circumstances, it is seen that in order to prevent our science from becoming 'a mere chaos of words,' every zoological author owes a serious nomenclatural duty, not only to himself and his colleagues of to-day but also to future generations of zoologists. If it were left to each author to accept or reject names according to his own personal wishes in the matter, the science of zoology would soon reach a stage in which it would be difficult for one author to understand the writings of another, hence in order to prevent such a chaotic state, systematists have felt themselves forced to adopt certain rigid rules in accordance with which any given animal has only one valid name, and that name shall be valid not only in the country in which it is proposed, but in all other lands as well.

The insistence on exactness in nomenclature is as important to the worker in systematic zoology or in geological distribution, as cleanness and sharpness of scalpel to the anatomist. No one failing to consider carefully his obligations in these regards, ever did first class work in the fields in question.

If there were only a few animals concerned,

we might give way to our tastes or prejudices in the choice of names. Most of us would rather say *Amphioxus* than *Branchiostoma, Pterichthys* than *Pterichthyodes, Lucioperca* than *Stizostedion*. But if we transgress our rules and use the later name or the preoccupied name in these familiar examples, we have no case against the man who follows his own whims throughout the series. We must either use the oldest names throughout, or else let anybody call anything what he pleases. This means absolute chaos in all lines of study where nomenclature is required.

The present code seems in all respects admirable. It covers the ground more fully than any other. In other words, it eliminates more successfully all the elements of whim, taste or individual preference. It is well to have names euphonious, descriptive and correctly formed. It is almost infinitely more important to have them stable, and there is no other way to stability save the rigid enforcement of rules which find their origin in the conditions of science itself.

In this code, zoological nomenclature is regarded as separate from botanical, though parallel with it. The law of priority is held paramount and nomenclature dates from 1758, the tenth edition of the 'Systema Naturæ' of Linnæus. No name is to be changed because of incorrect spelling or formation, nor rejected on account of inappropriateness. Generic names spelled differently are held to be distinct names, for a name is known by its spelling. Tautonomy (*Anguilla anguilla* and the like) is permitted. 'Once a synonym always a synonym' is a maxim adopted with an exact definition.

Some parts of the code are not sufficiently full. For example, the status of generic names of non-binomial authors subsequent to Linnæus is not clearly stated. Thus in 1763, Gronow published a number of genera of fishes, the species under each being given in polynomials. In other words, he recognized genera but did not adopt the binary system of Linnæus. The code does not leave it clear whether these post-Linnæan non-binominal genera should be adopted.

Mr. Stejneger (in letter, February 25, 1905) states that it was the judgment of the commission that the genera of non-binomial authors, dating after 1758, should be admitted. In the Code (Article 2) it states that 'the scientific designation of animals is uninomial for subgenera and all higher groups.' According to Stejneger, 'The rule applied to the generic term would be that the valid name of a genus can be only that name by which it was first designated on the condition that the author has *applied* the principles of the international rules by using a nominal designation.'

Under this ruling:

> Brisson and the others (Gronow, etc.) have applied the principle in question so *far as generic names are concerned*, and their generic names are, therefore, valid, while their binominals or trinominals are not valid though they may appear (accidentally) like true specific or subspecific names. The monomials are true generic names and must stand as such.

Another class of names claiming priority is not touched at all by this code. Klein (about 1744) defined a large number of genera of fishes. In a post-Linnæan compilation of Walbaum ('Artedi Piscium,' 1792), the diagnoses of all these pre-Linnæan genera are reprinted, although without formal adoption into the binomial system. These genera are mononomially defined, at a later date than 1758, and there is no doubt as to the species intended to be included in them. If these names had been original with Walbaum, they would be accepted without question. What is their status as reprints in a compilation?

The article (30) fixing the type of a composite genus is inadequate, and gives evidence of compromise among conflicting views. It is here that much of the present trouble in zoological nomenclature arises. The paragraph in question reads:

> If the original type of a genus was not indicated, the author who first subdivides the group may apply the name of the original genus to such restricted genus or subgenus as may be judged advisable, and such assignment is not subject to subsequent change.

This looks simple, but in practise it needs further definition. Many revisers have restricted the old genus to species with which

they are not themselves concerned. The type should be the best known species from the standpoint of the author. Frequently the first reviser (as of *Esox* and *Syngnathus*) selects as type a species which was by no means central or typical in the estimation of the original author. Still more frequently it is impossible to tell who is the first reviser, unless that phrase itself receive accurate definition. In the early days, many authors paid little attention to earlier genera, and in their reviews they encroached on the groups named by their predecessors, without limiting them or fixing their species. If the phrase is retained, the first reviser should be the one who first consciously limited the range of the genus by fixing the actual name to one of the actual original species. This at least is tangible. When a type is not fixed either by the original author or by his 'first reviser,' the code makes certain recommendations to the systematist. These seem to be of the nature of advice, and are void and of no effect when a type has been previously fixed. Third among these comes the method of elimination, a plausible process, but one which has never been defined and which in complex cases leads to as many different results as there are writers who attempt to use it.

In the code, these recommendations are made subordinate to the rule of the 'first reviser.' It is a question, however, whether the first and second of these recommendations (using as type the species suggesting the generic name as *Lutianus lutianus*, and using the one personally best known to the original author, as *Esox lucius*) should not have had precedence over 'the first reviser rule.' The present writer finds difficulty as above stated with the rule of the first reviser. In fishes, he finds the method of elimination practically worthless, at least, unless some rigid definition of it can be agreed upon. The arbitrary choice as type of the first species named under each new genus by its describer, is a rule which could have been enforced without confusion and which yet may be found necessary. It is, perhaps, too late now to go back to it, although several of the chief writers on fishes, Bleeker and practically Lacépède and Cuvier have more or less consistently adopted it. It is at least fair to apply this rule to these particular authors and to others who begin their account of each genus with the 'type' or 'chef de file.'

A great deal can be said in favor of a principle in nomenclature, which may be stated as follows: The determination of the significance of each name, generic or specific, must be made on evidence furnished by the author framing the name or on evidence existing at the time. It is possible to give an exact type to every genus or species on this basis, or in default of this to follow the simple and just rule of page precedence. This gives fixedness at least, and we need demand nothing else. This method would release zoology from the unwelcome and profitless task of finding out what an author means, by studying the effect of his words on his successors. In other words, our studies in this line would be limited to the author himself and to those on whom he may have relied. The adoption of the rule that a specific name might be identical with the name of a genus has saved us, in the aggregate, years of investigation among useless and forgotten synonyms. This same kind of study is forced upon us by the rule of the first reviser or the still more complex custom of the application of the method of elimination.

Dr. Stiles evidently appreciates the incompleteness of article 30, for he supplements it by twelve rules of his own, saying that 'No existing code of nomenclature provides for all cases that arise, so that authors make supplemental rules for themselves.' But these supplemental rules are necessarily parts of a completed code. The final form of this code should, therefore, contain or replace these twelve excellent rules of Dr. Stiles. Till this is done, we may recommend that these supplementary rules be favorably regarded by naturalists, though in our judgment page-precedence—as a remedy for taste or whim—will ultimately be given a place higher up the line than that assigned by Dr. Stiles, and 'absolute tautonomy,' 'virtual tautonomy' and the Linnæan rule of using 'the best known European or officinal species' as type

will take precedence over the fixing of the type by the first reviser.

In the present bulletin, besides the original text of the International Code, Dr. Stiles gives pertinent discussions and illustrations, for the purpose of making plain the reasons for the rules adopted. He gives also a valuable discussion of the proper application of various names used in medicine as applied to animal or bacterial parasites. Among these names are *Tænia, Echinococcus, Bacterium, Spirillum, Spirodiscus, Bacillus, Dipylidium, Dibothriocephalus* and *Monas.*

In conclusion we must congratulate Dr. Stiles for this most useful bulletin, which should be in the hands of every worker in systematic zoology, and most botanists would gain from its perusal.

David Starr Jordan.

*Handbuch der Geographischen Ortsbestimmung für Geographen und Forschungsreisende.* Von Dr. Adolph Marcuse, Privatdozent an der Universität Berlin. Braunschweig, Friederich Vieweg und Sohn. 1905. 8vo. Pp. 341; 55 illustrations.

The author has produced a useful and interesting book which, according to the preface, is intended primarily for the guidance of geographers and explorers, but incidentally also for teachers and students. Having in mind the needs of the latter, he has included in his manual many subjects by way of explanation or suggestion which would not be considered necessary in a work intended solely as a guide for the determination of positions with a degree of accuracy commonly considered sufficient for geographical purposes. Thus five pages are devoted to an exposition of the state of our knowledge of the variation of latitude. By way of suggestion he refers to the application of photography to the determination of geographical positions, promising the publication of a manual of the photographic method on the completion of certain experimental work which he apparently has in hand, and which must have made very satisfactory progress, to judge from his remark on page 250 to the effect that longitude can readily be determined by means of a portable photographic universal instrument to within one second of time. He also holds out the promise of success of some longitude work undertaken by Dr. Albrecht by means of wireless telegraphy. In this connection, it may be remarked parenthetically that the coast survey as early as 1901 obtained a satisfactory graphic record of wireless time signals sent to the Nantucket Station from the light ship for the purpose of testing the method of wireless longitude.

The requirements of the future are forestalled in an appendix on the determination of geographic positions by æronauts. He describes a quadrant which was actually used during a balloon voyage and gives an example of the results obtained. In connection with the use of Sumner's method by æronauts the author calls attention to the advantages of the use of 'Mercator's functions,' a name proposed by Börgen, who elaborated the new method of computation and published his formulæ and tables in the *Archiv der Deutschen Seewarte* (1898). On account of its simplicity and the avoidance of the usual logarithmic tables of the six circular functions, the new method is to be highly commended to navigators for whom it was devised. These references to Marcuse's book will be sufficient to indicate that it is by no means a mere rearrangement of old formulæ and methods.

The first chapter gives an explanation of celestial and terrestrial coordinates and of the variations to which they are subject. The second contains a very useful description of the Ephemerides published by various governments and evaluates their usefulness for different purposes. It gives descriptive and explanatory references to tables designed to facilitate computations, to star maps and celestial globes, etc.

The third chapter, which is devoted to instruments, gives a clear and very useful account of chronometers and their use. The author does not attempt to describe all known forms of instruments which might be used. Sextants and reflecting instruments he leaves to books on navigation. He recommends the use of the portable universal as the standard instrument which meets all requirements and

confines his descriptions to that form with the exception of a particular quadrant already referred to.

The fourth chapter treats of the methods which can be used most advantageously for determining time, latitude, longitude and azimuth.

The appendix, which, as already stated, gives attention to geographic determinations in the air, contains also a description with illustrative examples, of methods for determining time, latitude and azimuth without the use of graduated circles, methods for the application of which only a watch and a spool of thread are necessary auxiliaries.

The reader will be attracted by the beautiful typography and the excellence of the illustrations which enhance the value of the book.

O. H. T.

## SCIENTIFIC JOURNALS AND ARTICLES.

The opening (October) number of volume 12 of the *Bulletin of the American Mathematical Society* contains the following articles: 'The Elementary Treatment of Conics by Means of the Regulus,' by Charlotte Angas Scott; 'Arzela's Condition for the Continuity of a Function Defined by a Series of Continuous Functions,' by E. J. Townsend; 'Galois Field Tables for $p^n \leqq 169$,' by W. H. Bussey; Notes; New Publications.

The November number of the *Bulletin* contains: 'Report of the Twelfth Summer Meeting of the American Mathematical Society,' by F. N. Cole; 'A Set of Generators for Ternary Linear Groups,' by Ida May Schottenfels; 'Note on the Structure of Hypercomplex Number Systems,' by Saul Epsteen; 'A Geometric Property of the Trajectories of Dynamics,' by Edward Kasner; 'On the Possible Numbers of Operators of Order 2 in a Group of Order $2^m$,' by G. A. Miller; 'On the Arithmetic Nature of the Coefficients in Groups of Finite Monomial Linear Substitutions,' by W. A. Manning; 'A Modern Calculus of Variations' (Review of Bolza's Lectures on the Calculus of Variations), by E. R. Hedrick; 'Two Books on Analytic Geometry' (Review of Smith and Gale's Elements of Analytic Geometry and Introduction to Analytic Geometry), by O. D. Kellogg; Notes; New Publications.

*The American Naturalist* for September contains the following articles: 'Interrelationships of the Sporozoa,' by Howard Crawley, which opens with an excellent statement of the lines along which these animals have developed, and concludes that the term sporozoa should be used as a temporary and convenient cloak to cover certain protozoa. A 'Contribution to Our Knowledge of the Myxinoids,' by Julia Worthington, contains a large amount of interesting information, based on the Californian *Bdellostoma dombeyi*, concerning these little-known 'fishes.' F. C. Baker contributes 'Notes on the Genitalia of *Lymnea*.'

*Bird Lore* for September–October has three excellent illustrated papers, telling how to attract and preserve the winter birds. 'Our Avian Creditors,' by Ernest H. Baynes; 'The Winter Feeding of Birds,' by Mabel Osgood Wright, and 'How to Attract the Winter Birds,' by Edward H. Forbush. W. W. Cooke presents the twelfth paper on 'The Migration of Warblers' and there are 'Notes on Winter Feeding' by a number of contributors. Under the Audubon Societies is an appeal for funds for the widow of Game Warden Bradley and for the prosecution of his murderer, which it is hoped may meet with a ready response.

*The Museums Journal* of Great Britain has a frontispiece and brief article on the Central Section of the Museum of the Brooklyn Institute and an account of 'A Papier-maché Model of the Monk-fish.' The appointment of A. B. Skinner as director of the Albert and Victoria Museum is announced, he taking the place vacated by Sir C. Purdon Clarke. Mr. George Murray has resigned his position of keeper of the department of botany in the British Museum, a place he has held for the last ten years.

Three good papers appear as separates from the report of the Commissioner of Fisheries for 1903–1904: 'A Revision of the Cave Fishes of North America,' by Ulysses O. Cox; 'The Life History of the Blue Crab,' by W. P. Hay, and 'The Crab Industry of Maryland,' by Winthrop A. Roberts.

The Report of the Manchester Museum for 1904–1905 notes a deficiency in the finances of about $1,000, but causes one to wonder how so much good work as is accomplished by this institution can be done on an income of less than $15,000.

## DISCUSSION AND CORRESPONDENCE.

### CONTRIBUTIONS TO OUR KNOWLEDGE OF THE AERATION OF SOILS.

Under the above title Dr. Edgar Buckingham presents the results of a series of investigations relating to an important subject, in Bulletin No. 25 of the Bureau of Soils. As a practical problem in soil management the securing of those conditions which will insure a deep and ample ventilation is extremely needful; and hence any essential advance in our knowledge of the principles governing soil aeration is important. In the letter of submittal it is stated:

This paper presents for the first time definite information regarding the rate at which a gas escapes by diffusion from the soil into the atmosphere, or *vice versa*. It shows that the rate of diffusion varies approximately as the square of the porosity of the soil, and that this diffusion follows the laws for the free diffusion of gases. It thus becomes possible to calculate the rate of aeration in any particular soil from results obtained in experiments on free diffusion. Tables are given showing the rate of escape (and consequently, for a condition of equilibrium, the rate of formation as well) of carbon dioxide in the soil when the porosity of the soil and the concentration of the carbon dioxide at any given depth are known. The paper shows further that the aeration of soils is almost entirely due to diffusion phenomena changes in barometric pressure having very little influence in comparison.

The author in his 'Concluding Remarks' says:

1. We have measured the rate of flow of air under pressure by transpiration and of air and carbonic acid by diffusion, through four widely different soils, in varying states of structure, compactness and moisture content.

2. We have shown that the speed of diffusion of air and carbonic acid through these soils was not greatly dependent upon texture and structure, but was determined in the main by the porosity of the soil.

3. We have shown that the rate of diffusion was approximately proportional to the square of the porosity.

4. We have shown that when this relation is used to compute from our results the rate of free diffusion when no soil is present, it gives a result which is entirely consistent with what is already known from the work of other experimenters on the free diffusion of gases.

5. We have shown that when the porosity of a soil is reduced by compacting it, the ease with which air flows through it under the driving influence of a difference of pressure is greatly reduced, varying as the sixth or seventh power of the porosity.

6. We have investigated the depths to which free outside air might penetrate soils to different depths, under such barometric variations as are to be expected in average cases, if the outside air remained distinct from the soil air.

7. We have shown how to compute the rate of escape of carbonic acid from the soil by diffusion under given conditions of pressure, temperature, porosity and concentration of carbonic acid.

8. We have compared the linear velocities of diffusion and barometric transpiration, and hence—

9. We have shown that the escape of carbonic acid from the soil and its replacement by oxygen take place by diffusion and are determined by the conditions which affect diffusion, and are sensibly independent of the variations of the outside barometric pressure.

The foregoing remarks and conclusions are based on the mathematical treatment of a very limited series of laboratory experiments, which, however, have been executed with great care. The subject is one so complex and intricate that it can not be solved by so short and direct a cut and it is a matter for exceeding regret that this piece of work, admirable in itself so far as it goes, should be given out by the Department of Agriculture with so much of assurance of finality for its conclusions before they have been checked by even a single field observation or experiment. Almost infinite injury is done to the cause of agricultural science and to the growth of the Department of Agriculture along sound and enduring lines by prematurely exploiting results of investigation, striving to get them before the public eye of practical men—congressmen, farmers, merchants and manufacturers—but

succeeding in getting them there in the form of untruths, or of partial truths which lead to errors of practice so soon as they are applied. Lamentable examples of these are furnished in 'Bulletin 22' and in the extended press promulgation regarding what may be expected through bacterial inoculation of the soil. Much expense was incurred in conducting the investigations referred to and in getting them before the public; very much more is being incurred by those who are giving them practical trial; but by far the greatest expense will accrue during the time required to outgrow the disappointment and the smart of defeat, of wasted effort. It is this condition of things, more than ignorance and more than conservatism, which maintains with terrible effectiveness, as a brake on agricultural progress, the dogma, 'Book farming don't pay.'

In calling attention to the results of the author's investigations it is important to point out that rates of transpiration, as measured in the laboratory trials, are quite inapplicable for use in giving a measure of the rate of flow of air through soils under field conditions. It must be noted that in preparing the soils for the measurements of rates of transpiration they were 'first broken up fine in a mill.' This condition is very wide from what is found in the field and represents more nearly a puddled soil which is always a condition of sterility, and we believe that one of the chief causes of this sterility is the inadequate aeration possible under such conditions. In considering the results of the author therefore it must be borne in mind that he has measured the rates of transpiration—and of diffusion also—through a thin layer whose field structure had previously been altered by what may be designated dry-puddling. In illustration of the effect of dry-puddling we shall cite two series of observations made by Mr. Nelson and Mr. Hogenson, under our direction, while connected with the Bureau of Soils. They are taken from the records in the office of the bureau, which contain several hundreds of measurements covering many types of soil which have been examined as to the rates of transpiration in the first, second, third and fourth feet. In the particular cases cited we select two of the soils which were under investigation in 1903 upon which corn and potatoes were grown, as reported in Bulletin 26 of the Bureau of Soils. The rates of transpiration through these soils were measured under five different conditions, as indicated in the table. By 'field condition' is to be understood the granulation into which the soil falls naturally when plowed in good condition of moisture, but using only such portions of it as readily pass a one millimeter screen in the air dry condition and without rubbing. This soil was firmly packed in the transpiration tube and the rate of flow of air through it measured, after which it was returned to a mortar and pulverized by gently working it under a rubber pestle. When in this condition the transpiration was again measured, after which it was pestled a second time, the process being repeated until the rates of transpiration were obtained for the five different conditions.

MEAN RELATIVE RATES OF FLOW OF AIR THROUGH AIR DRY SOILS MORE OR LESS FINELY PULVERIZED.

| | Norfolk Sandy Soil. | | Janesville Loam. | |
|---|---|---|---|---|
| | Pore Space. | Seconds. | Pore Space. | Seconds. |
| Field condition, | 37.0 | 69 | 51.6 | 83 |
| Pestled once, | 31.8 | 1,050 | 48.5 | 600 |
| Pestled twice, | 29.9 | 1,724 | 48.5 | 800 |
| Pestled three times, | 29.1 | 2,025 | 47.9 | 1,200 |
| Pestled four times, | 28.5 | 2,550 | 46.8 | 1,350 |

It is clear from this table that a very profound change in the permeability of the two soils has been effected by the dry-puddling; the rate of flow of air through the Norfolk sand being finally reduced to only about one fortieth of what it was at first, and that of the Janesville loam to about one seventeenth. It will be observed also, if computations are made, that the rates have not varied as the sixth or seventh power of the porosity.

Under undisturbed field conditions the rate of transpiration would in all probability be very different from what is given in the first line of the table and for the surface foot; in air dry condition it is quite certain to be larger than there found. In actual field conditions the body of the soil is ramified by channels and passageways which are often larger than capillary and through which the air moves

more nearly in accordance with the laws controlling the flow through pipes. These passageways often cross-divide the soil itself into endlessly irregular and varying blocks, so that even deep in the ground both air and water flow in more or less open channels, percolation and transpiration taking place into these so that much of the mass movement of either air or water may occur without passing through capillary spaces. We have called attention to this fact in 'Movements of Ground Water'[1] and have there shown how far computations based upon laboratory trials may be from what occurs under natural conditions. These remarks apply with especial force to the surface one to four feet of field soils, the movements through which are of greatest agricultural importance. In this zone shrinkage cracks and passageways left by the decay of roots or formed by burrowing animals, it appears to the writer, influence in a very profound way the interchange of air as effected through changes of atmospheric pressure and cause the estimate of the author to be, in our judgment, very much below the true value.

The particular mode of action of atmospheric pressure which, it appears to us, must be most potent in causing an interchange of air in the surface soil has not been considered in the Bulletin under review. We refer to the pressure and suctional effects which result from, or are associated with, changes in wind velocity and the turbulency of the air movement at the earth's surface. The fluctuations of pressure to which we refer are of too short duration to be recorded by ordinary barographs, but they are nevertheless of sufficient length to be transmitted into the soil and their magnitude often exceeds some of those which the author has considered, while their frequency is very great. The agency which it appears to us is likely to be found most influential in the aeration of the surface soil is the wind itself, as it is the chief factor which effects a change of air in a house. As the air passes over the surface of a field, there must be maintained an excess of pressure on the windward side of obstructions to flow large and small of whatever kind, while on the leeward side there will be maintained a deficiency of pressure, so that on the whole air will be flowing into the soil in some places, traveling more or less horizontally and then rising to come out at places where the air pressure is less. And we do not see how it is possible that this influence can be limited to so small a depth as the author estimates for barometric 'rinsing.' Besides this, when the wind is blowing strong and is gusty in character there is a turbulency of flow analogous to that which occurs in a stream flowing down a rapid, giving to the air a downward thrust upon the surface, from which it rebounds, driving the air into the soil in some places and sucking it out in others.

But to these statements the author will doubtless reply that the writer is merely naming possible factors and doing so without testing their probable efficiency even mathematically. This is quite true, but both these and his own views can and should be checked by field observations and he is aware that we had begun a series of observations on the composition of soil air collected simultaneously at different depths down to four feet and that a considerable amount of the data so obtained are unpublished among the records of the bureau. He is well aware too that my object in having him called to the bureau was that he might make investigations along exactly the lines presented in the Bulletin, with many others, but to have him do so in conjunction with simultaneous field studies so that each line of work would supplement and check the other and be definitely related to observed crop and soil conditions. My criticism now is that the language of the Bulletin conveys the impression that such laboratory and mathematical treatment as he has presented have been sufficient to solve the method of soil aeration and to give a measure of the rate at which it occurs under field conditions, without making a field check on the results.

In regard to the longer period atmospheric waves, which the author has specifically considered, attention should be called to the fact that these, even when they are as short as

[1] 'Principles and Movements of Ground Water,' XIX. Annual Report, U. S. Geol. Survey, Part II., p. 249.

fifteen or twenty minutes, exert an influence which is great enough to very materially influence the discharge of water into wells, field drains, springs and river channels. It is well known too, in the case of breathing or blowing wells, that there is for days together a continuous flow of air out of and into the ground, the currents being strong enough, in a case which we have personally observed, to rattle loose two-inch planks lying over the well, itself nearly a hundred feet deep and four feet in diameter. In this particular case we were called to examine the well because it was impossible to prevent the suction pipe in the well freezing and bursting during the winter, caused by the large volume of cold air sinking into the well at times of high pressure when the thermometer was very low. The owner informed me that in digging the well, after a depth of eighty feet had been reached, work was stopped for the Christmas holidays and that after taking up the work again the gravel was found frozen so that a pick was necessary to loosen it before beginning digging.

We have observed fluctuations in the discharge of water from tile drains, associated with and apparently caused by changes of barometric pressure, amounting to fifteen per cent., and in the case of a deep well, discharging through a six-inch pipe, where the rate of flow was measured in a reservoir on ten consecutive days, the discharge per minute was found to vary between the wide limits of 15.441 and 13.947 cubic feet per minute,—a variation of fully ten per cent. We have also secured autographic records on the Wisconsin and Fox Rivers and from Lake Mendota which seem to indicate that the general seepage over wide areas changes its rate with changes in barometric pressure to such an extent that when the discharge is collected into channels the differences in depth are measurable, and when we have such changes as these it is difficult to believe that the inflow and outflow of air are not greater than is suggested by the conclusions of this Bulletin.

In regard to the influence of simple diffusion, in effecting soil aeration, it appears to the writer that the author has obtained values which must be much too large for field conditions. In carefully measuring the rates of diffusion, under the conditions of rigid control, which he did, the author has done exactly the right thing; but what is lacking is supporting field checks which are greatly needed in verifying the conclusions reached, particularly when the results are used so precisely as to compute the amount of carbonic acid escaping from a given field surface from the per cent. of carbonic acid found in the soil air at a given distance below the surface, where the porosity of the soil is known. Referring specifically to some of the author's data: If it is true, as indicated on page 39, that carbonic acid was escaping from soil in the flower bed in front of the building of the Bureau of Soils at the time of observation at the rate of .04 of a cubic foot per day and that it was being produced at this rate in the soil below the depth of six inches throughout the growing season—let us assume of 120 days—this would mean a production of carbonic acid, through the oxidizing of organic matter, at the rate of 209,088 cubic feet per acre; and, taking the weight of a cubic foot of carbonic acid at .12323 pounds, there would have been a loss from the soil of 7,026 pounds of carbon per acre. This amount of carbon represents, using an analysis of Hall's, 13,970 pounds of water-free grass per acre, or eight tons of hay containing the usual 15 per cent. of moisture. If we take Ebermayer's observations on the amount of carbonic acid in soil air, extending over a full year, except that August, September and October are not included, as given in the Bulletin, we shall find by the method of the author a still larger loss of carbonic acid. We use for this computation the mean amounts found for the year under the five conditions reported upon. At a depth of 15 centimeters (5.9 inches) the mean amount of carbonic acid found in the soil air was 1.09 per cent., the smallest amount in any single observation being .02 per cent., the next smaller .13 per cent. and the next .27 per cent., while the highest amount found was 4.61 per cent. Taking 120 days, as in the former case, and calculating from the table the amount of carbon carried out of the soil during this

period, expressing it again as dry grass on the basis of Hall's analysis, the amount required would be 27,420 pounds per acre or, expressed as hay containing 15 per cent. water, 15.7 tons. Again, using Ebermayer's determinations for the depth of 70 centimeters (27.6 inches) and 120 days, the computed loss of carbonic acid from the soil below this depth would be represented by that carried by 31,960 pounds of dry grass or 17.3 tons of hay per acre. In speaking of the first instance cited the author says: "We may say, then, that, in this case, carbonic acid is escaping from the soil at the rate of about 0.04 cubic foot per day per square foot and therefore that this was the rate of production of carbonic acid in the soil at this place below the depth of six inches." The amount of carbon thus carried out of the soil, according to the assumption and calculation, would be greater than the amount we have calculated above by whatever was produced in the surface six inches. It is clear, however, that no such losses of carbonic acid, resulting from the decomposition of organic matter, could be maintained year after year, as the amount of organic matter in the root system of a crop is not equal to that produced above ground, at least usually, and the amounts produced above ground are only rarely equal to the amounts computed; indeed they are seldom more than one third of those quantities. It must be concluded, therefore, that the laboratory observations and methods of computation give a rate of diffusion of carbonic acid from the soil of a field much greater than actually occurs as a seasonal average. It should be noted that in getting these enormous losses of carbonic acid from the soil we have included only one third of the year, while Ebermayer's observations show that the amounts present in the soil at all seasons, including even winter, are large.

In view of the relations to which we have called attention it is clear that the generalizations cited require critical field trials to be made, bringing them to suitable tests before they should be accepted with full confidence.

F. H. KING.

MADISON, WIS.,
September 16, 1905.

### THE QUESTION AS TO WHETHER FALCONS WHEN SOARING INTERLOCK THEIR PRIMARY WING FEATHERS.

THE observations of Mr. Trowbridge upon the habit of hawks when soaring to overlap their primaries (*i. e.*, on the upper side of the wing) have several times been commented upon adversely. And a well-known ornithologist has objected that this behavior of feathers has not been previously observed, in spite of the voluminous field notes as to the habits of hawks, and that no one has been able to confirm the observation of interlocking feathers. Accordingly, I am led to jot down the following notes in favor of Mr. Trowbridge's results, —for my observations are at first hand and were made, I believe, under quite favorable conditions.

It so happened that we were coming up the narrow canal from Sakai to Matsue in the face of a strong wind, so strong, indeed, that our small steamer labored to make headway against it. At one point we disturbed a kite, *Milvus melanotus*—a very common bird, by the way, along Japanese waterways—which rose slowly in the face of the wind and after making several circles followed the margin of the canal, flying and soaring, almost opposite the boat and making about equal headway. It did not occur to me at the moment that the opportunity was a favorable one for watching the wing feathers (for the bird was sometimes as near as a hundred feet), when my eye was caught by the behavior of the primaries. The hawk was flying low, about the height of the eye, and when the wing passed through the plane of the horizon I could see as the wing flapped that several primaries stood out sharply, finger-like, *dorsal* to the plane of the descending wing. This was so conspicuous, indeed, that it seemed difficult to conclude that these feathers could fold *under* one another when, in face of a strong wind, the wings became passive in soaring. Nevertheless, the distance of the bird was so great that I could not convince myself that the interlocking actually took place; I was only sure that the primaries were bowed, so that in soaring this part of the wing must have

been greatly strengthened by the closely opposed feathers. For several minutes the hawk thus flew alongside of the boat, with quite regular periods of flapping and soaring; then, suddenly shifting its course, it circled out, soaring, passing over my head at a distance of about twenty feet. I could then see plainly that the primaries of one wing (right) were interlocked—the condition of the other wing I had not time to observe.

My conclusion, therefore, is that the interlocking of the primaries of hawks takes place, as Mr. Trowbridge has shown, under the conditions of soaring in the face of a strong wind.

BASHFORD DEAN.

RINKAI JIKENJO, MISAKI-MIURA, JAPAN,
September 3, 1903.

## *SPECIAL ARTICLES.*

### THE CHROMOSOMES IN RELATION TO THE DETERMINATION OF SEX IN INSECTS.

MATERIAL procured during the past summer demonstrates with great clearness that the sexes of Hemiptera show constant and characteristic differences in the chromosome groups, which are of such a nature as to leave no doubt that a definite connection of some kind between the chromosomes and the determination of sex exists in these animals. These differences are of two types. In one of these, the cells of the female possess one more chromosome than those of the male; in the other, both sexes possess the same number of chromosomes, but one of the chromosomes in the male is much smaller than the corresponding one in the female (which is in agreement with the observations of Stevens on the beetle *Tenebrio*). These types may conveniently be designated as *A* and *B*, respectively. The essential facts have been determined in three genera of each type, namely, (type *A*) *Protenor belfragei*, *Anasa tristis* and *Alydus pilosulus*, and (type *B*) *Lygæus turcicus*, *Euschistus fissilis* and *Cœnus delius*. The chromosome groups have been examined in the dividing oogonia and ovarian follicle cells of the female and in the dividing spermatogonia and investing cells of the testis in case of the male.

Type *A* includes those forms in which (as has been known since Henking's paper of 1890 on *Pyrrochoris*) the spermatozoa are of two classes, one of which contains one more chromosome (the so-called 'accessory' or heterotropic chromosome) than the other. In this type the somatic number of chromosomes in the female is an even one, while the somatic number in the male is one less (hence an odd number) the actual numbers being in *Protenor* and *Alydus* ♀ 14, ♂ 13, and in *Anasa* ♀ 22, ♂ 21. A study of the chromosome groups in the two sexes brings out the following additional facts. In the cells of the female all the chromosomes may be arranged two by two to form pairs, each consisting of two chromosomes of equal size, as is most obvious in the beautiful chromosome groups of *Protenor*, where the size differences of the chromosomes are very marked. In the male all the chromosomes may be thus symmetrically paired with the exception of one which is without a mate. This chromosome is the 'accessory' or heterotropic one; and it is a consequence of its unpaired character that it passes into only one half of the spermatozoa.

In type *B* all of the spermatozoa contain the same number of chromosomes (half the somatic number in both sexes), but they are, nevertheless, of two classes, one of which contains a large and one a small 'idiochromosome.' Both sexes have the same somatic number of chromosomes (fourteen in the three examples mentioned above), but differ as follows: In the cells of the female (oogonia and follicle-cells) all of the chromosomes may, as in type *A*, be arranged two by two in equal pairs, and a small idiochromosome is not present. In the cells of the male all but two may be thus equally paired. These two are the unequal idiochromosomes, and during the maturation process they are so distributed that the small one passes into one half of the spermatozoa, the large one into the other half.

These facts admit, I believe, of but one interpretation. Since all of the chromosomes in the female (oogonia) may be symmetrically paired, there can be no doubt that synapsis in this sex gives rise to the reduced number of symmetrical bivalents, and that consequently

all of the eggs receive the same number of chromosomes. This number (eleven in *Anasa*, seven in *Protenor* or *Alydus*) is the same as that present in those spermatozoa that contain the 'accessory' chromosome. It is evident that both forms of spermatozoa are functional, and that in type *A* females are produced from eggs fertilized by spermatozoa that contain the 'accessory' chromosome, while males are produced from eggs fertilized by spermatozoa that lack this chromosome (the reverse of the conjecture made by McClung). Thus if $n$ be the somatic number in the female $n/2$ is the number in all of the matured eggs, $n/2$ the number in one half of the spermatozoa (namely, those that contain the 'accessory'), and $n/2-1$ the number in the other half. Accordingly:

In fertilization

$$\text{Egg } \frac{n}{2} + \text{spermatozoon } \frac{n}{2} = n \text{ (female).}$$

$$\text{Egg } \frac{n}{2} + \text{spermatozoon } \frac{n}{2} - 1 = n - 1 \text{ (male).}$$

The validity of this interpretation is completely established by the case of *Protenor*, where, as was first shown by Montgomery, the 'accessory' is at every period unmistakably recognizable by its great size. The spermatogonial divisions invariably show but one such large chromosome, while an equal pair of exactly similar chromosomes appear in the oogonial divisions. One of these in the female must have been derived in fertilization from the egg-nucleus, the other (obviously the 'accessory') from the sperm-nucleus. It is evident, therefore, that all of the matured eggs must before fertilization contain a chromosome that is the maternal mate of the 'accessory' of the male, and that females are produced from eggs fertilized by spermatozoa that contain a similar group (*i. e.*, those containing the 'accessory'). The presence of but one large chromosome (the 'accessory') in the somatic nuclei of the male can only mean that males arise from eggs fertilized by spermatozoa that lack such a chromosome, and that the single 'accessory' of the male is derived in fertilization from the egg nucleus.

In type *B* all of the eggs must contain a chromosome corresponding to the large idiochromosome of the male. Upon fertilization by a spermatozoon containing the large idiochromosome a female is produced, while fertilization by a spermatozoon containing the small one produces a male.

The two types distinguished above may readily be reduced to one; for if the small idiochromosome of type *B* be supposed to disappear, the phenomena become identical with those in type *A*. There can be little doubt that such has been the actual origin of the latter type, and that the 'accessory' chromosome was originally a large idiochromosome, its smaller mate having vanished. The unpaired character of the 'accessory' chromosome thus finds a complete explanation, and its behavior loses its apparently anomalous character.

The foregoing facts irresistibly lead to the conclusion that a causal connection of some kind exists between the chromosomes and the determination of sex; and at first thought they naturally suggest the conclusion that the idiochromosomes and heterotropic chromosomes are actually sex determinants, as was conjectured by McClung in case of the 'accessory' chromosome. Analysis will show, however, that great, if not insuperable, difficulties are encountered by any form of the assumption that these chromosomes are specifically male or female sex determinants. It is more probable, for reasons that will be set forth hereafter, that the difference between eggs and spermatozoa is primarily due to differences of degree or intensity, rather than of kind, in the activity of the chromosome groups in the two sexes; and we may here find a clue to a general theory of sex determination that will accord with the facts observed in hemiptera. A significant fact that bears on this question is that in both types the two sexes differ in respect to the behavior of the idiochromosomes or 'accessory' chromosomes during the synaptic and growth periods, these chromosomes assuming in the male the form of condensed chromosome nucleoli, while in the female they remain, like the other chromosomes, in a diffused condition. This indicates that during these periods these chromosomes play a more active part in the metabolism of the

cell in the female than in the male. The primary factor in the differentiation of the germ cells may, therefore, be a matter of metabolism, perhaps one of growth.

Edmund B. Wilson.

Zoological Laboratory,
Columbia University,
October 3, 1905.

### THE GEOGRAPHICAL DISTRIBUTION OF THE BELL-TOADS.

At the meeting of the Association of American Geographers in Philadelphia, December 29, 1904, I read a paper on the 'Geographical Distribution of the Discoglossoid Toads in the Light of Ancient Land Connections,'[1] in which I made the following statement:

> All indications point towards the country southeast[2] of the Himalayas as the original center of the radiation of the discoglossoid toads, as well as of their near relations the pelodytoid toads. The former are not now found in this region; but that fact weighs but little in view of *Ascaphus* having remained unknown on this continent till 1899, and thus far known only from a single specimen.

This statement assumes almost the character of a prophesy in view of the fact that Dr. G. A. Boulenger, a month later, announced the discovery of a bell-toad (*Bombina*) in the province of Yunnan, near Tong Chuan Fu, at an altitude of about 6,000 feet. This new species, *Bombina maxima* (Boulenger), thus indicates the central form from which both the European and the Korean bell-toads have sprung. Confirmatory of this, it may be mentioned that the new species in most essentials agrees with *Bombina orientalis* and *B. salsa*, the latter being the more southern and, in my opinion, the more primitive of the two European species.

The discovery of this species lends further weight to the theory propounded by me for the migration of this genus[3] in the following terms:

> Of the various theories which might be advanced in order to explain this distribution it seems most reasonable at present to select the one which presupposes a comparatively late immigration of this genus from southeastern Asia into Europe after a late Miocene land connection had been established—a theory which would account for the failure of these toads to reach Spain on the one side and Japan on the other.

The supposed original central form in southeastern Asia has now been found, and the theory to a great extent verified almost at the very moment of its publication.

Leonhard Stejneger.

U. S. National Museum,
Washington, D. C.,
August 31, 1905.

[1] Résumé published in *Amer. Geogr. Soc. Bull.*, XXXVII., February, 1905, pp. 91–93.

[2] In the résumé quoted 'southwest' through a lapsus or misprint.

[3] *L. c.*, p. 93.

### HYDRATION CAVES.

The conclusions set forth in my paper 'On the Origin of the Caves of the Island of Put-in-Bay, Lake Erie,'[1] were based mainly upon observations, made last year, in Perry's Cave. The conditions, however, which exist on the island, led me to believe that the hydration of anhydrite has played an important rôle in the formation of all the caves. At that time I was able to visit three of the four caves open to the public, namely, Perry's, Kindt's and the Crystal Caves. Concerning the other cave, Daussa's, the following statement was, however, made in the paper referred to above: "But inasmuch as this cave is in very close proximity to Perry's Cave, the above explanation, no doubt, also applies to it."

During another visit to the island several weeks ago, Daussa's Cave was visited and it was noted that the fitting of the roof and floor is to be observed fully as well in this cave as in Perry's, leaving, therefore, no doubt whatever as to the origin of the same.

From the general topographic features of the island and the mainland in that vicinity —especially that which is known as Catawba Island—one is led to believe that careful searching should reveal more of these interesting caves, which differ so much in their origin and structure from the ordinary solution cave, that I would suggest they be termed

[1] *American Geologist*, XXXV., 167–171, March, 1905.

*hydration caves,* because of the fact that, as previously shown, the process of hydration has been such an important factor in their formation.

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### A PRELIMINARY NOTE ON CLOVER DISEASES IN TENNESSEE.

FOR a few years past there has been considerable complaint among Tennessee farmers of the failure of the red clover crop. A careful investigation of the question was begun by the botanical department of the Tennessee Experiment Station early in the present season, and a short account of the present stage of these investigations may be of some interest.

While the whole state has been more or less explored with reference to diseases affecting clover, the immediate region about Knoxville has been more carefully studied, and may be assumed as typical of the situation throughout Tennessee, and perhaps adjoining states.

The crop begins to die in the summer following late winter sowing. The trouble has been popularly attributed to some supposed condition of the soil, and so termed 'clover sickness' of the land. It was soon learned, however, that the malady is independent of soil conditions, and there was at the outset a strong presumption in favor of some fungous or bacterial disease. Our later investigations have fully justified this opinion.

Early in the season a few leaves were found to be attacked by the clover rust, *Uromyces trifolii* (Hedw.) Lev. This disease occurs so sparingly that it may be left out of consideration. Careful search frequently reveals the presence of *Pseudopeziza trifolii* (Bernh.) Fuck. While this fungus caused considerable damage in some instances, it may also be left out of account.

A rather destructive disease, apparently caused by *Macrosporium sarcinæforme* Cav.,[1] is very frequent and widely disseminated. It often appears on stray alsike plants (*Trifolium hybridum* L.) associated with the red clover, which is not true of any other parasites discussed in this paper. The *Macrosporium* disease appears capable of destroying the clover plant unassisted by any other parasite, though this statement is based only on inspection in the field.

The most destructive disease thus far found is what appears to be an undescribed species of *Colletotrichum.* In its general appearance this disease very closely simulates the anthracnose of clover (*Stengelbrenner*), described by Mehner[2] and Kirchner[3] and by the latter attributed to the attacks of *Glœosporium caulivorum* n. sp.

The *Colletotrichum* species here referred to causes considerable injury to young clover plants in early summer, where it confines its attacks to the petioles of the leaves. Its greatest damage, however, is done to blooming and fruiting plants, where it attacks the stems most often just below the flower heads, but frequently at other points, causing the sudden blackening and death of a limited region, eventually destroying the entire plant.

A description and characterization of this species will shortly appear, and further experiments now under way will be described in a forthcoming bulletin of the Tennessee Experiment Station.

SAMUEL M. BAIN,
SAMUEL H. ESSARY.
UNIVERSITY OF TENNESSEE,
KNOXVILLE, TENN.

[1] Cited in Tubeuf and Smith, 'Diseases of Plants,' 1896, p. 517; also Malkoff, *Zeits. f. Pflanzenkr.*, Bd. XII., pp. 283–285.

[2] *Zeits. f. Pflanzenkr.*, Bd. XI., p. 193, 1901.

[3] *Ibid.*, Bd. XII., p. 10.

### A NEW ARMORED DINOSAUR FROM THE UPPER CRETACEOUS OF WYOMING.

THE writer has recently been fortunate in the discovery, near Lander, Wyoming, of the larger part of a skeleton of a remarkable dinosaur, evidently new. The animal is about half the size of *Stegosaurus,* to which it is allied, but is peculiar in having a heavy bony carapace, two inches or more in thickness. This carapace is covered with, and for the most part firmly united to, a mosaic of pentagonal dermal bony plates, much like those of *Glyptodon.* Each plate is about four inches

in diameter, scrobiculate and somewhat elevated in the middle. The whole was evidently covered with a dermal shield, and probably each eminence bore a more or less elongated horny spine. How much of the creature was covered by this heavy shield it is yet impossible to determine; possibly only the pelvic region was so protected, as in *Polacanthus*, since there is also preserved a series of large bony plates or scutes, each of about the size of one's hand, united transversely with each other, and bearing in the middle a prominent longitudinal keel. In addition, numerous flattened bony scutes were preserved, each measuring about three inches in diameter. There are no osseous spines. The bones of the skeleton are solid; the front legs are smaller than the hind ones; the dorsal centra are amphiplatyan, 75 mm. in width by 70 in length, with elevated arches, as in *Stegosaurus* or *Polacanthus*. The head is small, the teeth in size and form resembling those of *Paleoscincus* Leidy. The tibiæ measure 145 mm. in width distally.

The beds in which this interesting specimen was discovered are composed of dark blue shales, from 30 to 75 feet in thickness, immediately overlying and conformable with the Benton Cretaceous. They have been traced continuously for more than forty miles, becoming thinner to the west, where they plainly show littoral and river disturbances. Two continuous lines near the middle, the upper one of white clay, the lower of ferruginous shales, everywhere permit the exact allocation of the fossils. The associated fossils are three or four species of plesiosaurs, one of them clearly belonging in the genus *Polycotylus*, hitherto unknown from above the Niobrara; a large species of a teleosaur crocodile; and a half dozen species of small gastropods and pelecypods, the latter occurring in myriads, in ofttimes massive concretions, about twenty feet above the clay line; plesiosaur bones are sometimes found mingled with shells in the concretions. The invertebrates are of a fresh-water or brackish-water facies.

About thirty feet above these shales there is a layer of sandstone containing rarely a species of *Ostrea;* above which there are about six hundred feet of sandstones and shales containing many characteristic Pierre invertebrates and a varied flora of dicotyledonous leaves. Surmounting the whole are not less than two thousand, and more probably three thousand, feet of light-colored Pierre shales. Fox Hills deposits have not been detected, unless in the massive sandstones immediately below the Laramie deposits.

I believe that the beds containing the vertebrates are of Niobrara age, and they may possibly represent the Belly River. That the dinosaur may prove to be generically identical with *Paleoscincus*, known from the Belly River and Laramie deposits by teeth only, is not impossible. I venture, however, to suggest the name of Hailey shales for the beds containing it, and the name *Stegopelta landerensis* for the dinosaur itself.

S. W. Williston.

University of Chicago,
September 28, 1905.

## *QUOTATIONS.*

### SHALL THE UNIVERSITY BECOME A BUSINESS CORPORATION?

In the settlement of the larger questions of administration—the choice of president and of professors, the fixing of greater questions of policy—may not some council composed of trustees and faculty jointly share the responsibility to advantage? Whatever may be said in favor of the sound judgment of the well-trained business man, I can not doubt that he would be a wiser councilor for education if he could hear first-hand the views of devoted, intelligent scholars. On the other hand, will not the scholar profit equally by such contact, and is there any surer way to widen his horizon and to give him the experience which ripens judgment than to offer him a share in the responsibility of settling these larger questions, while relieving him at the same time of part of the pressure of the daily routine? In a word, recognition of scholarship in the choice of a president, an adjustment of duties which shall relieve the pressure upon the professor and student, a better contact between the governing body and the teaching body, with a common responsibility in the settle-

ment of the larger questions, seem to me distinct and practical steps in the direction of development which the university administration ought to study.

For one must not forget in considering the administration of a university that there are to every form of administration two sides: the mechanical and the spiritual. The mechanical part of administration is that which provides the machinery necessary to carry out a given enterprise. The other side of administration, the spiritual side, consists in getting out of men the best there is in them. For a set of perfect men any administrative system would suffice. Good administration consists in taking men as they are, with their prejudices, their faults, their virtues, and in getting out of them the highest results of which they are capable.

Now, our attention has been given of late years, in American university life, increasingly to the mechanical side of administration, and the machinery has been made to approximate more and more closely, both in its form and in its choice of executive officers, to the practise of the business corporation. Its very closeness and compactness of organization are in some respects its chief faults. That which is mechanical is always simpler than that which is living. To-day we need, in my judgment, to concern ourselves in the university with the spiritual side of administration.

It has been my purpose rather to state questions than to argue them; not to propose a substitute for our present administration of the university, but rather to point out certain tendencies in it. To inquire whether, if the republic be the ideal system of administration, it is not also a good one for the scholar, and to ask, at least in these days when events move so rapidly, whether the administration of the university as it is now organized tends toward the development of a larger type of professor and a finer order of students; to ask whether we are developing the mechanical side of the administration at the expense of the spiritual side.

For after all, we can never too often remind ourselves that the first purpose of the university is not to further industrial development or to increase the wealth of a state, but that it is the development of the intellectual and spiritual life. This development can take place only in the air of freedom, however evident are the dangers which freedom brings with it. Wealth, power, the niceties of life, may all grow in an atmosphere of limited or of artificial freedom, but only in the air of real freedom can be grown that spirit and that intelligence which shall minister to those things which are spiritual and to those things which are eternal.—President Henry S. Pritchett, of the Massachusetts Institute of Technology, in *The Atlantic Monthly*.

### AGRICULTURE IN THE SCHOOLS.

A DISTINCT step in the direction of encouraging the teaching of agriculture in the high school is the movement to recognize that work in the entrance requirements of higher institutions. To a certain extent these higher institutions determine what must be taught in the high schools leading up to them. Heretofore there has been no inducement to schools that were fitting for the colleges and universities to offer such courses, however much they might desire to do so, and no incentive to a student to take agricultural work if it were offered, since it would not entitle him to credit in meeting the entrance requirements.

This matter has been under consideration in several states, for it has been recognized as a bar to progress in introducing agricultural studies. Definite action has now been taken in Missouri. The university in that state practically determines what shall be taught in the high schools, as students are admitted to it on their accredited high school work. Members of the agricultural faculty have been urging that agricultural work in the schools should be given some recognition, and the council of the university has recently decided to allow a credit of one unit on the entrance requirements for a year's work in agriculture in a high school. Boys who are planning to pursue the agricultural course in the university can now take elementary work in the high school without endangering their standing for entrance to the university. It is believed that this recognition will stimulate the

offering of agricultural subjects in the high schools, and that advantage will be taken of this opportunity by a considerable number of pupils. Several of the schools have shown an interest in agricultural work and desired to introduce it, but have been deterred by the necessity of meeting the requirements in the subjects credited.

A somewhat conditional victory in this direction has also been gained in New York state. There the state regents of education determine what subjects are to be credited in the regents' examinations for entrance to colleges or universities in the state, and agriculture has not been included in the list. Naturally no other subjects would be offered at high schools except as electives, and pupils fitting for college would not be likely to take such elective studies with no chance for credit. This has handicapped the college of agriculture at Cornell in its efforts to extend the teaching of nature study and elementary agriculture in the public schools, and that institution has brought its influence to bear upon the regents of education. At a meeting held last winter the regents decided to allow credits in the regular high school courses for nature study and elementary agriculture, provided the courses in these subjects were so prepared as to show educational values comparable with other subjects now recognized. Since this announcement the faculty of the college of agriculture has been at work on the syllabi of courses in the subjects under consideration, with a view to securing their approval by the board of regents. In that case it is expected that several of the high schools will offer elective courses in agriculture, which will enable them the better to prepare students for the higher agricultural work of the college.

It was the contention at the meeting of the Association of American Agricultural Colleges and Experiment Stations at Des Moines last fall, that the public schools should lead up to the agricultural colleges as they now do to colleges of arts and sciences; and President Jesse explained that in Missouri 'we are risking our entire future on the doctrine that the college of agriculture should rest on the public high school, and we are going to make the public high school agricultural so far as it ought to be agricultural.' The recognition of agriculture as a teaching subject and as having an educational value will do much to bring about this desired end. It will bring elementary and advanced work in agriculture closer together, and will articulate the agricultural college and the high school as they have not been before.—*The Experiment Station Record.*

## *BOTANICAL NOTES.*

### MORPHOLOGY OF THE EAR OF INDIAN CORN.

Mr. E. G. Montgomery, of the University of Nebraska, in a paper soon to be published, offers a new explanation of the morphology of the 'ear' of Indian corn (*Zea mays*). Briefly stated it is that the ear corresponds to the central spike of the tassel. This normally bears from four to eleven rows of paired spikelets. In the staminate inflorescence one of the spikelets in each pair is sessile, and the other stalked, but in their transformation to the pistillate structure the pedicel of the stalked spikelet becomes shortened more and more until it is sessile, thus forming a double row of kernel-producing spikelets, and accounting for the fact that the ear always has an *even* number of rows. Hermaphrodite flowers are common in such transformed spikelets.

### A NEW BOTANICAL TEXT-BOOK.

Under the name of 'A College Text-book of Botany' Professor Atkinson has brought out (Holt & Co.) an enlargement and considerable improvement of his 'Elementary Botany' (1898). In it the author has attempted to present an outline of the science in a form sufficiently condensed to be readily covered by college students in the time usually allotted to botany in the better class of colleges and universities. The book differs from most of those hitherto prepared in the sequence of topics, beginning with physiology, to which thirteen chapters (135 pages) are assigned. Following this are twenty-four chapters (213 pages) on the morphology of plants. Eight chapters (115 pages) are given to 'Plant Members in Relation to their Environment,' fol-

lowed by twelve chapters (184 pages) on 'Vegetation in Relation to Environment.' Seventy-five pages (9 chapters) are given to the structure and classification of angiosperms. A useful appendix contains suggestions as to the collection of material, the selection of apparatus, reagents, reference books, etc. One has but to note the space given to the subdivisions of the science to realize the change which has taken place in our conception of its scope, and the relative importance of its departments. Roughly speaking, 20 per cent. of the book is given to physiology, 30 per cent. to morphology, 40 per cent. to ecology and but about 10 per cent. to classification. The college student who successfully covers the subject as presented in this book will have a very good introduction to the several departments of the science.

The general decapitalization of generic names when used alone strikes one rather oddly, as when we find spirogyra, vaucheria, uncinula, rhabdonia, riccia, marchantia, etc. Even family names may suffer decapitalization, as 'gramineæ' (p. 658).

### KARSTEN AND SCHENCK'S VEGETATIONSBILDER.

QUITE recently several more fascicles of this admirable publication of photographs of vegetation have been received from the publisher, Gustav Fischer, of Jena. As in the earlier fascicles noticed in SCIENCE for April 7, 1905, each of these contains six fine reproductions of photographs accompanied by full explanatory text. Thus fascicle 1, of Series III., contains six photographs by E. Ule of ant nests (Blumengärten) in Brazilian vegetation; fascicle 2, six photographs by Dr. E. A. Bessey, of vegetation in Russian Turkestan (1, moving sand dunes on the Amu Daria River; 2, sand dunes held by Calligonum, Salsola, and Tamarix; 3, *Tamarix laxa* and *Salsola arbuscula;* 4, *Haloxylon ammodendron* and *Salsola arbuscula;* 5, *Calligonum arborescens;* 6, *Cuscuta engelmanni* on a quince tree). The third fascicle is by Dr. M. Busgen, Dr. H. Jensen and Dr. W. Busse, and includes photographs of vegetation in middle and eastern Java. Of these the most striking are those of the teak and bamboo forests. The low price of these beautiful plates (2.50 Marks per fascicle) should enable every botanist to own a complete set.

### FURTHER PLANT CELL STUDIES.

SEVERAL months ago (July 7, 1905) parts I. to IV. of Dr. B. M. Davis's 'Studies on the Plant Cell' were noticed in these columns. Since that notice was written two more parts have appeared (*American Naturalist,* July and August). They are devoted to a discussion of cell activities at critical periods of ontogeny in plants, which are taken up under several heads: (1) Gametogenesis (in which we find the suggestion that 'the most satisfactory theory of the origin of sex in plants regards primitive gametes as weaker or lacking in the potentialities of vegetative growth, and conjugation as a mutually cooperative process resulting in a rejuvenescence of the protoplasm'); (2) fertilization (in which the author suggests a narrower conception of the act, by excluding 'vegetative fertilization'); (3) sporogenesis; (4) reduction of the chromosomes (in which much new matter is here incorporated in a concise statement); (5) apogamy (under which he discusses parthenogenesis); (6) apospory; (7) hybridization (in which we find this significant sentence—"the phenomenon of hybridization is far too complex to be explained in terms of simple ratios, and while some characters may be paired or correlated in proportions that can be expressed by mathematical formulæ, there is little probability that the assemblage of characters which make species can be so definitely grouped as the strongest disciples of Mendel may hope"); (8) xenia ('the immediate or direct effect of pollen on the character of seeds and fruits'). Under the last title it is stated that 'the best understood examples of xenia are found in the hybrids of maize.' The whole discussion in these two parts covers ninety-six pages, and includes a bibliography of 152 titles.

### A STUDY OF INSECT GALLS.

DR. M. T. COOK, now of the Agricultural Experiment Station at Santiago de las Vegas, Cuba, has brought together in orderly form what is known as to the Indiana plant galls

produced by insects, and this has been published in the 29th Report of the Department of Geology and Natural Resources of Indiana, and also issued as a seventy-page 'separate.' The plan of this brochure is as follows: (1) a short historical section, (2) biology and classification of gall-insects, (3) morphology of galls, (4) causes inducing gall formation, (5) a systematic account of Indiana galls, (6) bibliography. Illustrations from drawings and photographs serve to make the descriptions easier to follow.

This little booklet should stimulate interest in these curious structures, about which there has been practically nothing written in this country in any systematic or connected way until Dr. Cook took up the matter. He is now at work on a monograph of the insect galls of North America, in which the galls will be classified with reference to the host plants, and the treatment is to be primarily from the standpoint of the plant pathologist. It is to be hoped that botanists and entomologists will help in this undertaking by sending him specimens of all kinds of galls from different localities.

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## *TECHNICAL EDUCATION IN AUSTRALIA.*[1]

THE necessity for providing the means of imparting technical education has been unreservedly acknowledged in each of the states of the Australian Commonwealth, the annual combined expenditure in this direction being over £60,000, exclusive of the cost of land, buildings, etc. In Sydney, after successful experiments in the formation of classes by one of the state subsidized educational institutions, a technical education board was established, which did good work until 1889, when the state government assumed control of the movement, the work of technical education being handed over to the state department of public instruction. The technical college, forming the headquarters of the system, is one of the leading architectural features of Sydney. The fronts of the main structure are ornamented with Romanesque carvings in white stone, showing representative flora and fauna of Australia. The main entrance is formed by a triple arch, with two center columns of polished bluestone or trachyte, flanked by two pilasters of the same material. The main building to which access is thus gained has three floors and a half-basement, and contains 28 rooms, many well lighted, lofty and suitable class-rooms. There is a chemical laboratory, and at the rear of the main structure are electrical engineering, plumbing, sanitary engineering, blacksmiths' shops and well-equipped general engineering shops. In 1903 there were 477 technical classes in operation, of which 243 were held in Sydney and suburbs and 234 in the country districts, while there were in addition 86 classes held in connection with the public schools. The number of individual students under instruction during the year was 13,232, and the average weekly attendance 8,671. In 1896 a technical college was opened at Newcastle, and a new college at Bathurst in June, 1898. In 1902 a technical school was built at Lithgow, and mechanical engineering shops provided at Newcastle. During the year the expenditure by the government on technical education amounted to £26,459, exclusive of expenditure on the technical museum and branches. Fees to the amount of £8,707 were received from the students. In Victoria much has been done in promoting the work of technical education, a patriotic Victorian having assisted the earlier stages of the movement by giving £15,500 towards the establishment of a workingmen's college. In 1903 there were eighteen schools of mines and technical schools receiving aid from the state. The total state expenditure during the year was £16,430, and the fees received from students amounted to £11,741. The average number of students enrolled was 3,173. In addition, classes in manual training and in cookery and domestic economy are held at various centers, the net expenditure on these branches amounting in 1902–3 to £3,437. In South Australia the Adelaide School of Design in 1903 had 577 students. There were also branch schools at Port Adelaide and Gaw-

[1] Communicated to the *Journal of the Society of Arts* by Mr. John Plummer, of Sydney.

ler. The School of Mines and Industries, founded in 1889, received state aid in 1903 to the extent of £3,658, while the receipts from fees and sale of materials to students amounted to £3,691. Queensland is beginning to display increased interest in the movement, a board of technical instruction having been appointed in 1902, holding its first examination at the close of 1903, when 960 students were examined, two thirds obtaining certificates of competency. In the same year there were twenty technical schools distributed through the state, with an enrolment of 2,600 students. The amount of fees, etc., collected was £13,385, and that of the expenditure £14,280, showing the system to be almost self-supporting. In Western Australia a technical school has been opened at Perth, having now an average attendance of 190, the annual expenditure amounting to nearly £6,000. Tasmania has also technical schools in Hobart and Launceston, the average attendance, including that of the two schools of mines, being 540, the annual expenditure being under £3,000.

## *THE INAUGURATION OF PRESIDENT DRINKER.*

IN connection with the celebration of Founder's Day, Lehigh University installed its new president, Mr. Henry Sturgis Drinker, on October 12, in the Packer Memorial Chapel. Mr. Robert H. Sayre, president of the board of trustees, made the installation address, which was followed by a brief response from President Drinker. The greetings of the alumni were tendered in an address by Mr. Frank P. Howe, of the class of '78. Following the installation ceremonies, an oration in memory of Asa Packer, the founder of the university, was delivered by the Hon. Hampton L. Carson, attorney general of Pennsylvania, his subject being 'Practical Ideals.' The service in the chapel was then adjourned to the site selected for the erection of the Drown Memorial Hall, where the sod was turned by Mr. Robert H. Sayre, and addresses in memory of the late President Brown were made by Dr. Charles R. Dudley, chief chemist of the Pennsylvania Railroad and chairman of the general committee on the Drown Memorial Fund, and Dr. Rossiter W. Raymond, Dr. Drown's successor as secretary of the American Institute of Mining Engineers. The almuni, faculty and guests of the university were received by the president and trustees at a luncheon in the gymnasium, where in the evening an alumni dinner was given in honor of President Drinker. Addresses were made by Mr. Harlan Sherman Miner, '88, for the alumni; President Isaac Sharpless, of Haverford College, for the invited guests; Bishop Talbot, of South Bethlehem, for the trustees; Professor Mansfield Merriman, for the faculty, and the president of the senior class for the undergraduates.

## *THE INSTALLATION OF PRESIDENT JAMES AT THE UNIVERSITY OF ILLINOIS.*

THE ceremonies in connection with the installation of Dr. Edmund Janes James as president of the University of Illinois is taking place this week. At the inaugural exercises addresses are expected by:

Hon Charles S. Deneen, Governor of Illinois.

Hon. Samuel A. Bullard, president of the Board of Trustees.

Hon. Andrew S. Draper, former president of the university and commissioner of education, state of New York.

after which President James is to deliver his inaugural address and degrees are to be conferred. Professor T. J. Burrill, professor of botany and vice-president of the university, is announced to welcome delegates who are expected to respond as follows:

President James B. Angell, of the University of Michigan, for the state universities.

President Ira Remsen, of Johns Hopkins University, for eastern universities.

Chancellor Frank Strong, of the University of Kansas, for western universities.

President Edwin B. Craighead, of Tulane University, for southern universities.

Vice-President Harry P. Judson, of the University of Chicago, for the universities and technical schools of the state.

President Charles H. Rammelkamp, of Illinois College, for the colleges of the state.

President John W. Cook, of the Northern Illinois State Normal School, for the normal schools of the state.

Principal Benjamin F. Buck, of the Lake View High School, for high schools of the state.

There are being held during the week a large number of assemblies and conferences, including a conference on 'Religious Education in State Universities and Colleges,' a conference on 'Commercial Education' and 'A National Conference of College and University Trustees.' Among those announced to speak at the latter congress are the Hon. Andrew S. Draper, president Henry S. Pritchett and Professor Charles E. Bessey.

## SCIENTIFIC NOTES AND NEWS.

IN memory of Professor DeWitt B. Brace, head of the department of physics of the University of Nebraska, whose death we were compelled to record last week, the new physics building, the construction of which he supervised and into which he was about to move, will be named Brace Hall.

PROFESSOR G. E. HALE, director of the Mt. Wilson Solar Observatory, on September 30, gave a lecture in the Cavendish Laboratory, Cambridge University, on 'The Development of a New Method in Solar Research,' and on October 4 he gave a lecture at a special meeting of the Royal Astronomical Society on the 'Solar Observatory on Mount Wilson, California.'

THE medical profession of Chicago will give a banquet to Dr. Nicholas Senn on Saturday, November 11. The committee of arrangements consists of Drs. William A. Evans, Frank Billings, John B. Murphy, William L. Baum and David J. Doherty.

DR. C. H. GILBERT, who has been working during the summer on the deep-sea fishery collections at Washington, has returned to Stanford University.

MR. J. H. BATTY, who has been collecting mammals, birds and reptiles for the American Museum of Natural History in Mexico for several years past, finished his work in southern Sinaloa in November of last year, going thence overland through Tepic to Jalisco, where he has since been making important collections. Several shipments from Jalisco have already reached the museum, containing hundreds of birds and mammals, besides many reptiles and insects, accessories for groups and a large number of valuable photographs. During the last two or three months he has been exploring the fauna of Mount Colima and the adjacent regions.

DR. H. BECHHOLD has been appointed a member of the Royal Institute for Experimental Pathology at Frankfort.

THE Royal Commission on the Care and Control of the Feeble-Minded, consisting of Mr. W. P. Byrne, C.B., Mr. W. H. Dickinson, Dr. H. B. Donkin, Dr. J. C. Dunlop and Mrs. Pinsent, left Liverpool for the United States on October 2 to study American methods of treating the insane.

PROFESSOR W. E. CASTLE, of Harvard University, will lecture before the New York Association of Biology Teachers, on the evening of October 20, his subject being 'The Experimental Study of Heredity.'

PROFESSOR EDGAR L. HEWETT, of Washington, will lecture on October 30 at the American Museum of Natural History before the American Ethnological Society, on 'The Life and Culture of the Tewa Indians in Pre-Spanish Times.'

PROFESSOR H. MARSHALL WARD, F.R.S., delivered the inaugural address at the opening of the present session of the Southeastern Agricultural College, at Wye, England, taking as his subject 'Botany and Agriculture.'

DR. J. W. LOWBER, F.R.G.S., F.R.A.S., of Austin, Texas, has been elected a member of the Royal Societies Club of London.

SIR WILLIAM WHARTON, F.R.S., hydrographer of the British Navy, died at Cape Town, on September 29, of enteric fever. Sir William Wharton was president of the Section for Geography at the meeting of the British Association in South Africa.

DR. WILHELM JOHANN FRIEDRICH VON BEZOLD, professor of physics and meteorology at the University of Berlin and director of the Prussian Meteorological Bureau, died on September 13, at the age of sixty-eight years.

THE death is announced of Dr. Alexander Hay Japp at the age of sixty-six years. He

was a man of letters who wrote a life of Thoreau, books on Darwin and some works on natural history.

M. ALEXIS PACHE, with three natives, was killed in August, by an avalanche, while making explorations in the Himalayas.

THE generosity of a friend of the American Museum of Natural History enables the department of ornithology to plan to assemble a special collection of Birds of Paradise. Many species of this family are now becoming so rare that specimens can be secured only with difficulty. Mr. Chapman, associate curator of ornithology, while attending the fourth International Congress of Ornithologists in London recently, took advantage of the occasion to examine the stocks of London dealers in natural history supplies and was fortunate in procuring some desirable material for use in the proposed group.

PEABODY MUSEUM of Yale University has received a large cabinet of shells from the estate of the late O. P. Hubbard.

THE International Congress of Radiology, which met recently at Liège, has decided to hold another congress in five years, which was placed under the charge of an international committee.

WE learn from the *Bulletin of the American Mathematical Society* that the Academy of Sciences of Berlin held its Leibnitz session on June 29. The Steiner prize was not awarded, but the sum of six thousand Marks was set apart in recognition of the investigations of the late Professor Guido Hauck.

THE following resolution was passed by the Congress of Tuberculosis recently held at Paris: "The congress, after hearing the *exposé* of the most recent investigations, declares that it is not only indispensable to avoid contagion from man to man, but also to pursue the prophylaxis of bovine tuberculosis and to continue to take administrative and hygienic measures to avert its possible transmission to our species, and finally that it is desirable to be on our guard against all forms of animal tuberculosis."

PROFESSOR W. C. UNWIN delivered the inaugural address of the opening session at the City and Guilds Central Technical College, taking as his subject 'The Niagara Power Stations.' Professor W. E. Ayrton, the dean, presided. According to the London *Times* Professor Unwin, in the course of his address, which was freely illustrated by lantern views, pointed out that if the total energy due to the fall from Lake Erie to Lake Ontario could be utilized it would amount to 7,000,000 horsepower. At the fall itself the horsepower of the descending water was about 4,000,000. The first great scheme for utilizing the water power resulted in the formation of the Niagara Falls Power Company, who obtained, in 1886, the right to develop 200,000 horsepower on the American side, and later 250,000 horsepower on the Canadian side. Work on a canal and tunnel for 100,000 horsepower was commenced, and in 1890 Mr. Adams went to London to consult the engineers on that side of the Atlantic. A competition for hydraulic and electric plans was started. A commission with Lord Kelvin as chairman was formed to consider the plans. The competition practically settled the hydraulic arrangements to be adopted, but two or three years of conferences and discussion elapsed before a really practicable scheme of electrical distribution for all purposes was threshed out. Professor Unwin gave a detailed description of the plant of the Niagara Falls Power Company, and referred to the chief points of interest in the undertakings of the Ontario Power Company, the Canadian Power Company, and the Electrical Development Company. Dealing with the question of the destruction of the falls, he stated that in 1885 Mr. Evershed thought he was taking a very safe line in saying that for power purposes no more than 4 per cent. would be required. If 150,000 horsepower were produced the daily demand would be 11,000 cubic feet per second, which was 5 per cent. of the mean flow, or not quite 7 per cent. of the minimum flow. The development of 650,000 horsepower demanded 48,000 cubic feet per second, or $21\frac{1}{2}$ per cent. of the mean flow and 30 per cent.

of the minimum flow. It was obvious that when the whole of the machinery was in working order the appearance of the falls would be startling. Taking into account the water used for the Welland Canal and Chicago drainage and other canals projected the total diversion of water would be at least 41 per cent. of the minimum flow. Nor was the end of projects for the diversion yet in sight, so that there seemed likely to be a fulfillment of Lord Kelvin's prophecy that before long Niagara would be a dry ravine.

## UNIVERSITY AND EDUCATIONAL NEWS.

Sir Donald Currie has offered £20,000 to Queen's College, Belfast, on condition that an equal sum is otherwise raised. A large portion of the necessary sum has already been promised.

Mr. Basil McCrea, of Belfast, has given £6,000 to found a chair of experimental physics in Magee College, Londonderry, and to provide two scholarships in connection therewith, on condition of the subscription of funds for a suitable laboratory within a certain period.

The trustees of the Carnegie Foundation to provide pensions for college professors will hold their first meeting in New York City on the afternoon of November 15.

The president of the Louisiana State University announces that as the yellow fever quarantines are still in force, it is deemed best not to open the university until November 1. The session will close on June 27, 1906. Perhaps it would be safe to open at an earlier date, but the university authorities wish to be sure of avoiding all danger, not only of infection in the school, but of detention of students by quarantine. There have been seven sporadic cases of yellow fever in Baton Rouge since September 4, but there has been no yellow fever at the university, and no serious sickness of any kind.

There have this year registered at Stanford University 590 new students as compared with 488 last year. They are distributed among the departments as follows:

| | 1904. | 1905. |
|---|---|---|
| Greek | 4 | 8 |
| Latin | 18 | 23 |
| German | 27 | 28 |
| Romanic Languages | 8 | 14 |
| English | 69 | 87 |
| Psychology | — | 4 |
| Education | 5 | 11 |
| History | 27 | 38 |
| Economics | 27 | 29 |
| Law | 52 | 97 |
| Drawing | 3 | 6 |
| Mathematics | 14 | 14 |
| Physics | 3 | 3 |
| Chemistry | 24 | 31 |
| Botany | 3 | 6 |
| Physiology | 17 | 12 |
| Zoology | 12 | 10 |
| Entomology | 1 | 2 |
| Geology and Mining | 53 | 41 |
| Civil Engineering | 49 | 47 |
| Mechanical Engineering | 37 | 33 |
| Electrical Engineering | 35 | 47 |

There are this year 713 students in the freshman class of Harvard University, as compared with 788 students last year.

An instructorship in the department of physics of the University of Pennsylvania is vacant. Applications may be addressed to Professor Arthur W. Goodspeed.

Professor Nathaniel Butler has been appointed dean of the College of Education of the University of Chicago to fill the vacancy caused by the resignation of Professor H. E. Locke.

Austin Cary, A.B., has been appointed assistant professor of forestry at Harvard University, and R. T. Fisher, A.B., has been promoted to an assistant professorship in the same subject.

Professor A. Emch, of the University of Colorado, has been appointed professor of mathematics at the Cantonal College of Solothurn, Switzerland.

Dr. Th. Paul, director of the scientific department of the Bureau of Health at Berlin, has accepted a call to the professorship of pharmacology and applied chemistry at Munich.